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Python

The Complete Manual

The essential handbook for Python users

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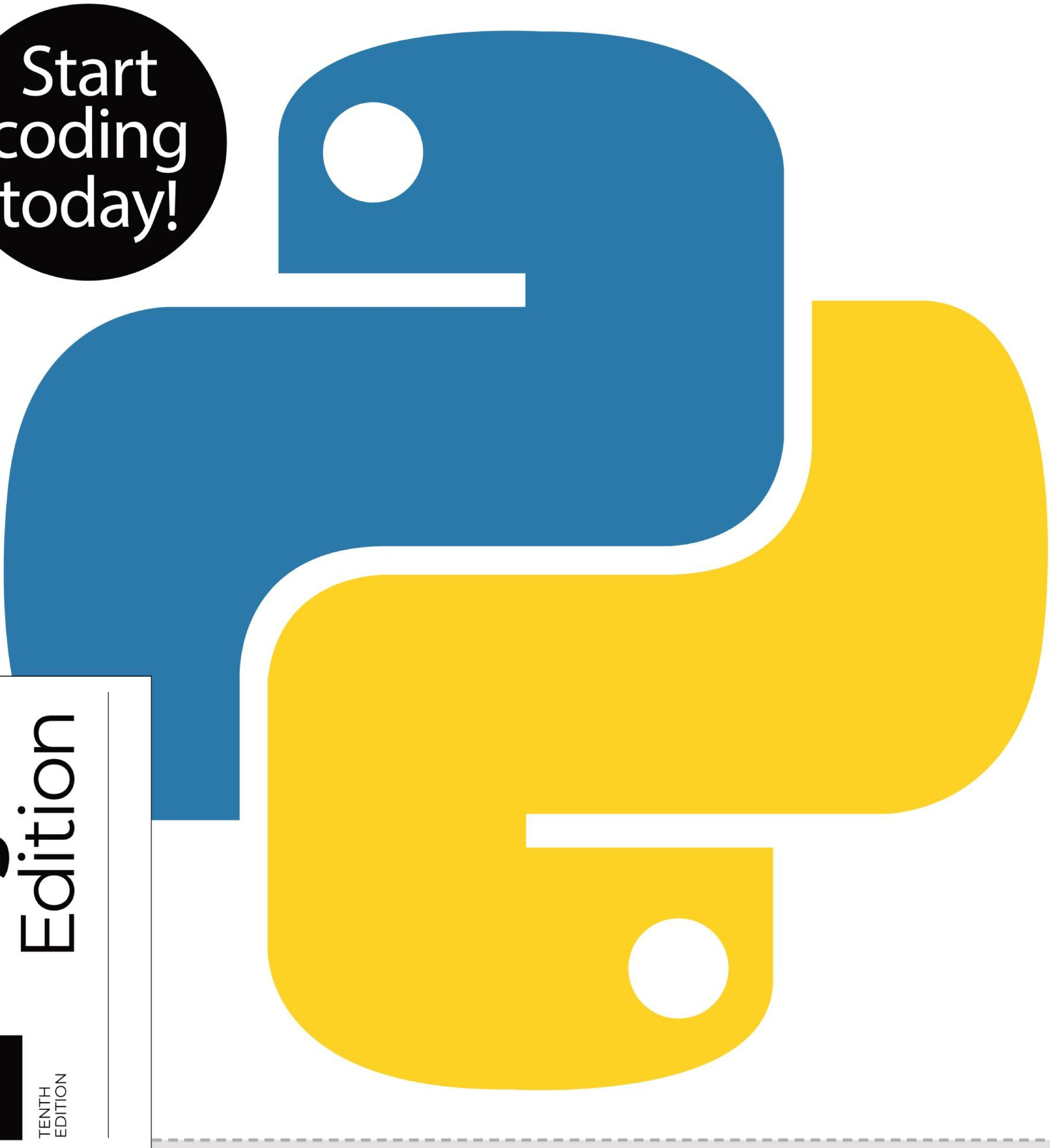

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Python
The Complete Manual

Python is a versatile language and its rise in popularity is certainly no surprise. Its similarity to everyday language has made it a perfect companion for the Raspberry Pi, which is often a first step into practical programming. But don't be fooled by its beginner-friendly credentials – Python has plenty of more advanced functions. In this new edition, you will learn how to program in Python, discover amazing projects to improve your understanding, and find ways to use Python to enhance your experience of computing. You'll also create fun projects including programming a *Space Invaders* clone and teaching your Raspberry Pi to multi-task. Let's get coding!

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Python

The Complete Manual

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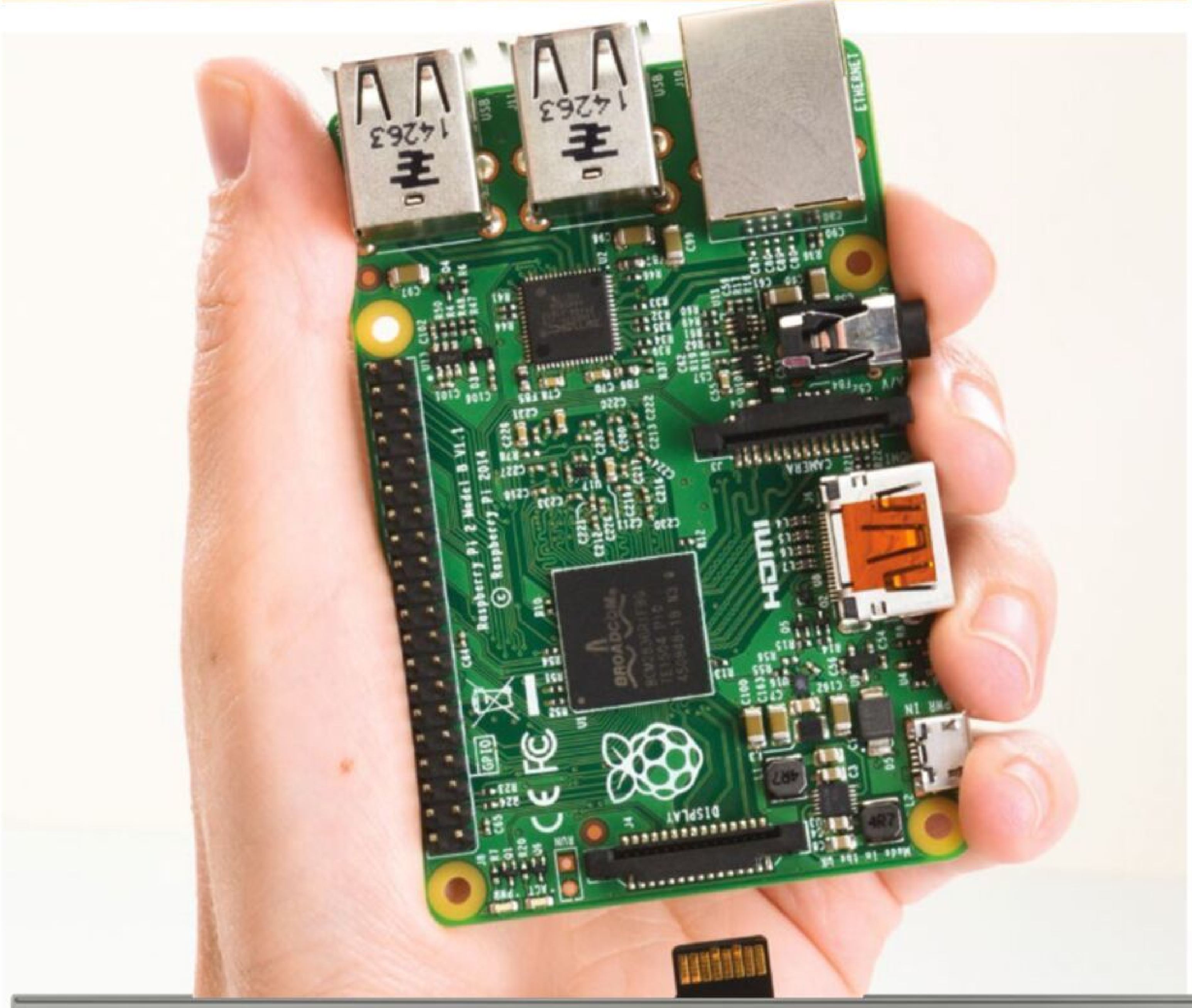

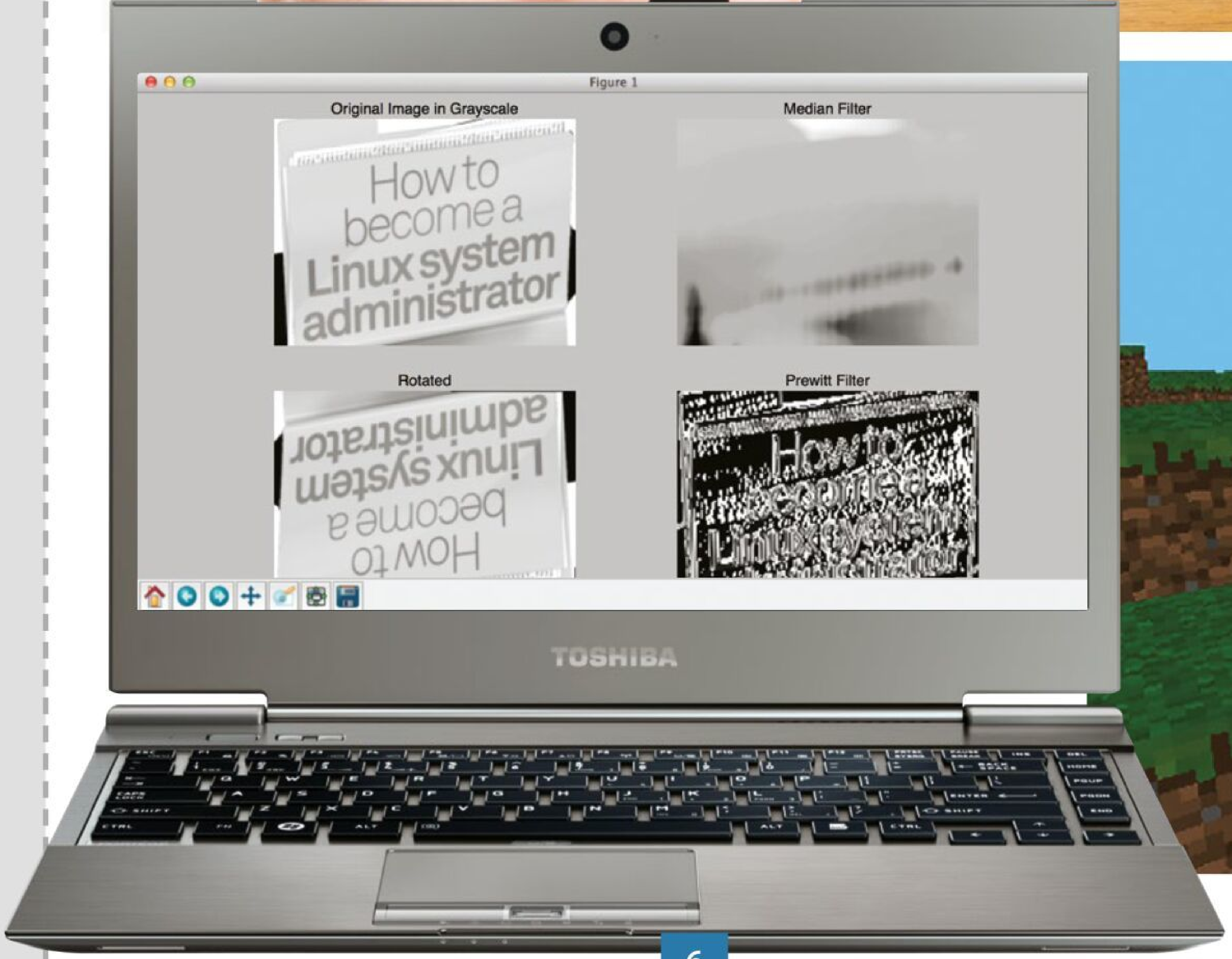
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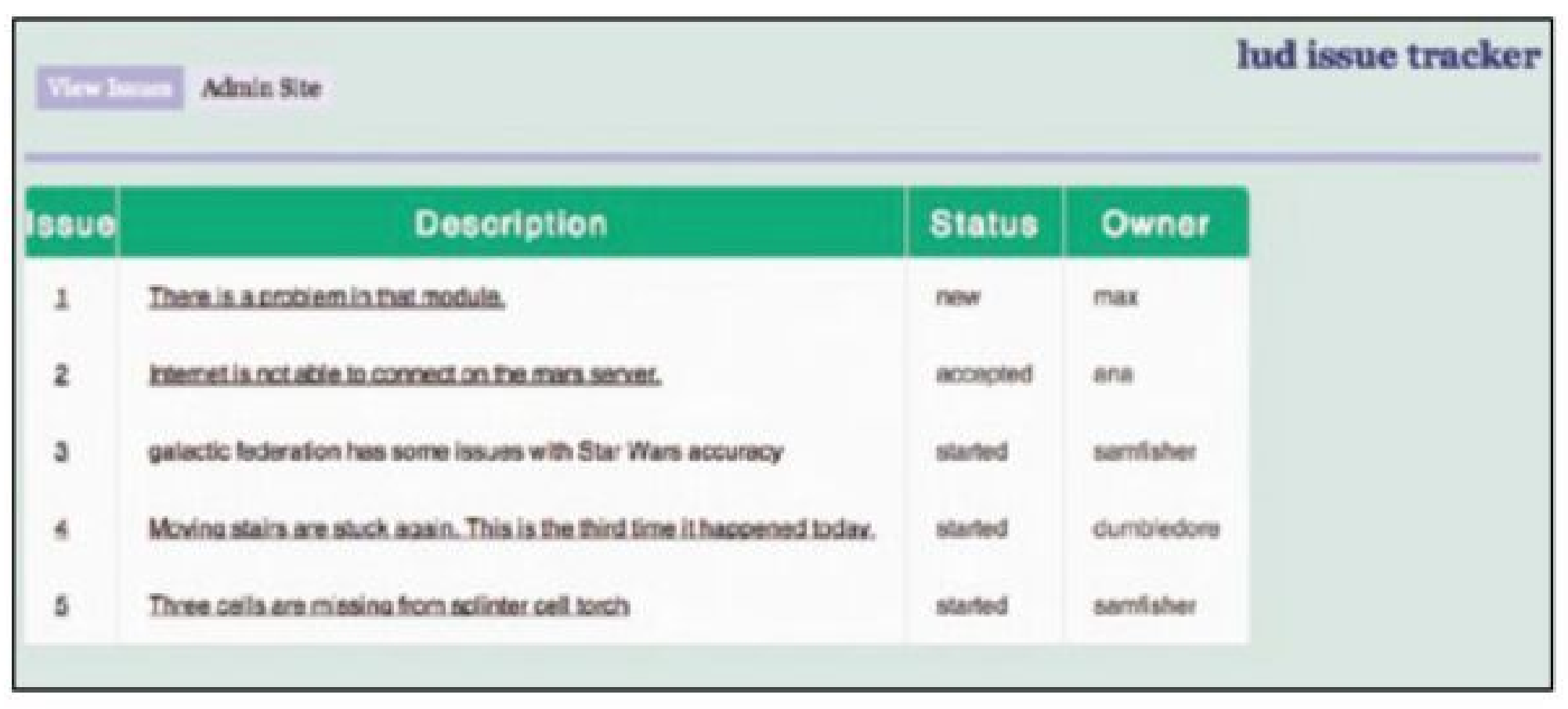

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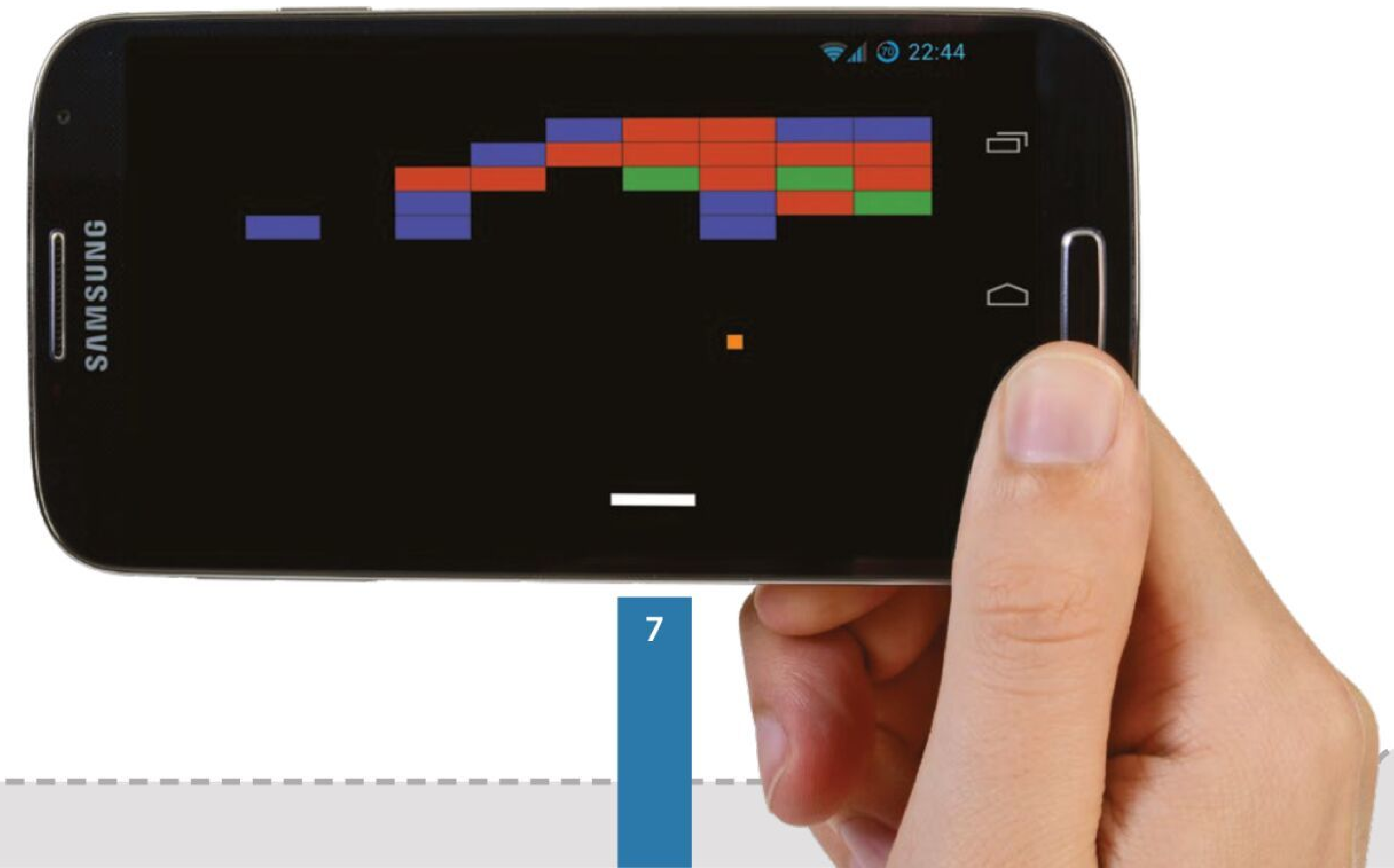


Get started with Python

Always wanted to have a go at programming? No more excuses, because Python is the perfect way to get started!

Python is a great programming language for both beginners and experts. It is designed with code readability in mind, making it an excellent choice for beginners who are still getting used to various programming concepts.

The language is popular and has plenty of libraries available, allowing programmers to get a lot done with relatively little code.

You can make all kinds of applications in Python: you could use the Pygame framework to write simple 2D games, you could use the GTK libraries to create a windowed application, or you could try something a little more ambitious like an app such as creating one using Python's Bluetooth and Input libraries to capture the input from a USB keyboard and relay the input events to an Android phone.

For this tutorial we're going to be using Python 2.x since that is the version that is most likely to be installed on your Linux distribution.

In the following tutorials, you'll learn how to create popular games using Python programming. We'll also show you how to add sound and AI to these games.

Hello World

Let's get stuck in, and what better way than with the programmer's best friend, the 'Hello World' application! Start by opening a terminal. Its current working directory will be your home directory. It's probably a good idea to make a directory for the files that we'll be creating in this tutorial, rather than having them loose in your home directory. You can create a directory called Python using the command mkdir Python. You'll then want to change into that directory using the command cd Python.

The next step is to create an empty file using the command 'touch' followed by the filename. Our expert used the command touch hello_world.py. The final and most important part of setting up the file is making it executable. This allows us to run code inside the hello_world.py file. We do this with the command chmod +x hello_world.py. Now that we have our file set up, we can go ahead and open it up in nano, or alternatively any text editor of your choice. Gedit is a great editor with syntax highlighting support that should be available on any distribution. You'll be able to install it using your package manager if you don't have it already.

```
[liam@liam-laptop ~]$ mkdir Python
[liam@liam-laptop ~]$ cd Python/
[liam@liam-laptop Python]$ touch hello_world.py
[liam@liam-laptop Python]$ chmod +x hello_world.py
[liam@liam-laptop Python]$ nano hello_world.py
```

Our Hello World program is very simple, it only needs two lines. The first line begins with a 'shebang' (the symbol #! – also known as a hashbang) followed by the path to the Python interpreter. The program loader uses this line to work out what the rest of the lines need to be interpreted with. If you're running this in an IDE like IDLE, you don't necessarily need to do this.

The code that is actually read by the Python interpreter is only a single line. We're passing the value Hello World to the print function by placing it in brackets immediately after we've called the print function. Hello World is enclosed in quotation marks to indicate that it is a literal value and should not be interpreted as source code. As we would expect, the print function in Python prints any value that gets passed to it from the console.

You can save the changes you've just made to the file in nano using the key combination Ctrl+O, followed by Enter. Use Ctrl+X to exit nano.

```
#!/usr/bin/env python2
print(“Hello World”)
```

You can run the Hello World program by prefixing its filename with ./ – in this case you'd type: ./hello_world.py.

```
[liam@liam-laptop Python]$ ./hello_world.py
Hello World
```

Variables and data types

A variable is a name in source code that is associated with an area in memory that you can use to store data, which is then called upon throughout the code. The data can be one of many types, including:

Integer	Stores whole numbers
Float	Stores decimal numbers
Boolean	Can have a value of True or False
String	Stores a collection of characters. “Hello World” is a string

> “A variable is associated with an area in memory that you can use to store data”

Tip

If you were using a graphical editor such as gedit, then you would only have to do the last step of making the file executable. You should only have to mark the file as executable once. You can freely edit the file once it is executable.

Tip

At this point, it's worth explaining that any text in a Python file that follows a # character will be ignored by the interpreter. This is so you can write comments in your code.

As well as these main data types, there are sequence types (technically, a string is a sequence type but is so commonly used we've classed it as a main data type):

List	Contains a collection of data in a specific order
Tuple	Contains a collection immutable data in a specific order

A tuple would be used for something like a co-ordinate, containing an x and y value stored as a single variable, whereas a list is typically used to store larger collections. The data stored in a tuple is immutable because you aren't able to change values of individual elements in a tuple. However, you can do so in a list.

It will also be useful to know about Python's dictionary type. A dictionary is a mapped data type. It stores data in key-value pairs. This means that you access values stored in the dictionary using that value's corresponding key, which is different to how you would do it with a list. In a list, you would access an element of the list using that element's index (a number representing where the element is placed in the list).

Let's work on a program we can use to demonstrate how to use variables and different data types. It's worth noting at this point that you don't always have to specify data types in Python. Feel free to create this file in any editor you like. Everything will work just fine as long as you remember to make the file executable. We're going to call ours variables.py.

Interpreted vs compiled languages

An interpreted language such as Python is one where the source code is converted to machine code and then executed each time the program runs. This is different from a compiled language such as C, where the source code is only converted to machine code once – the resulting machine code is then executed each time the program runs.

Full code listing

```
#!/usr/bin/env python2

# We create a variable by writing the name of the
variable we want followed# by an equals sign,
which is followed by the value we want to store
in the# variable. For example, the following line
creates a variable called# hello_str, containing the
string Hello World.
hello_str = “Hello World”
```

The following line creates an integer variable called hello_int with the # value of 21. Notice how it doesn’t need to go in quotation marks

```
hello_int = 21
```

The same principal is true of Boolean values

```
hello_bool = True
```

We create a tuple in the following way

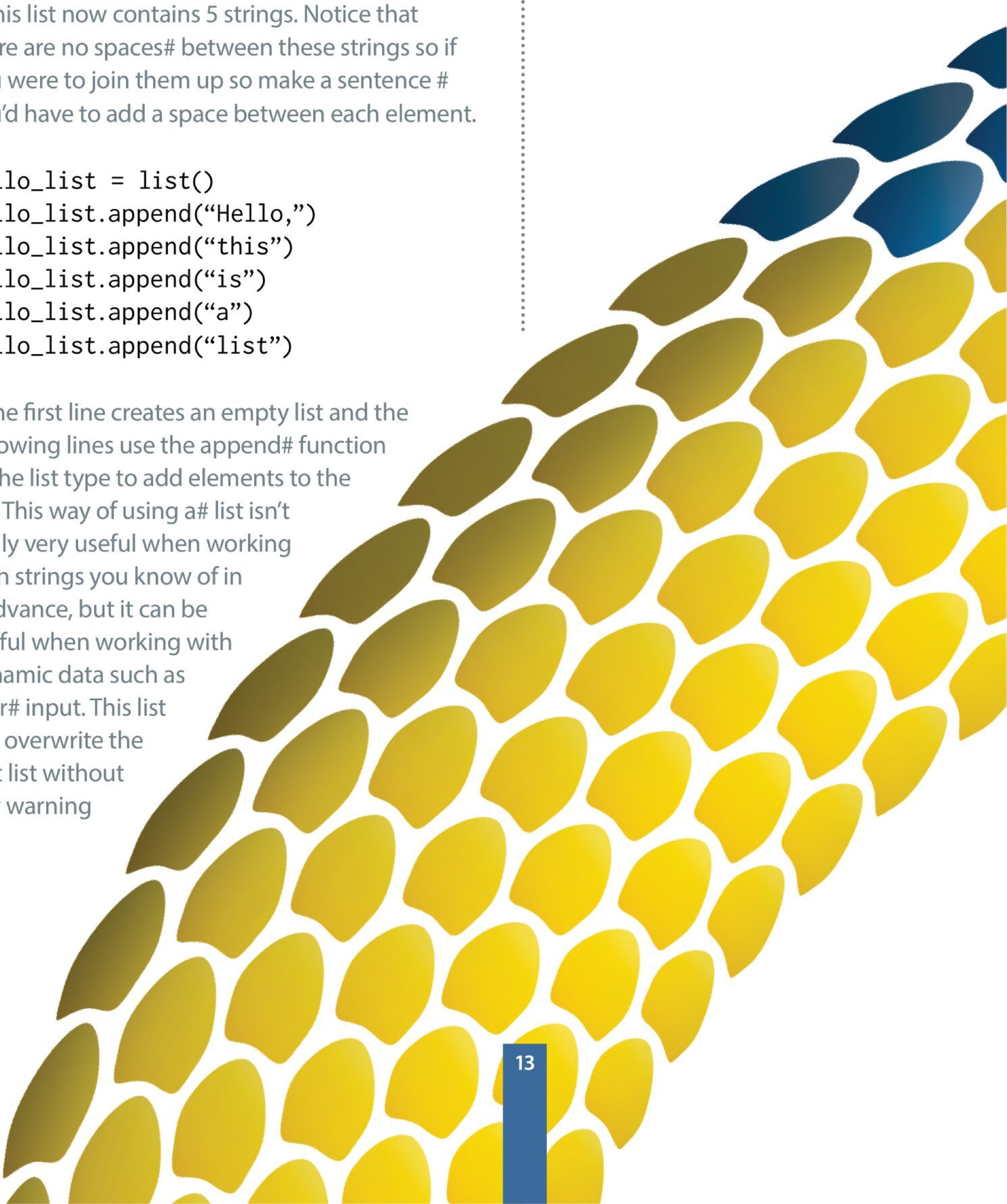
```
hello_tuple = (21, 32)
```

And a list in this way

```
hello_list = [“Hello,”, “this”, “is”,
“a”, “list”]

# This list now contains 5 strings. Notice that
there are no spaces# between these strings so if
you were to join them up so make a sentence #
you’d have to add a space between each element.
```

You could also create the same list in the following way

```
hello_list = list()
hello_list.append(“Hello,”)
hello_list.append(“this”)
hello_list.append(“is”)
hello_list.append(“a”)
hello_list.append(“list”)

# The first line creates an empty list and the
following lines use the append# function
of the list type to add elements to the
list. This way of using a# list isn’t
really very useful when working
with strings you know of in
# advance, but it can be
useful when working with
dynamic data such as
user# input. This list
will overwrite the
first list without
any warning
```



Get started with Python

```
as we# are using the same variable name as the
previous list.
```

We might as well create a dictionary while we're at it. Notice how we've aligned the colons below to make the code tidy

```
hello_dict = { "first_name" : "Liam",
               "last_name"  :
"Fraser",
               "eye_colour" : "Blue" }

# Let's access some elements inside our
collections# We'll start by changing the value
of the last string in our hello_list and# add an
exclamation mark to the end. The "list" string is
the 5th element # in the list. However, indexes
in Python are zero-based, which means the
# first element has an index of 0.
```

Notice that there will now be two exclamation marks present when we print the element

```
print(hello_list[4])
hello_list[4] += "!"
# The above line is the same as
hello_list[4] = hello_list[4] + "!"
print(hello_list[4])
```

Remember that tuples are immutable, although we can access the elements of them like so

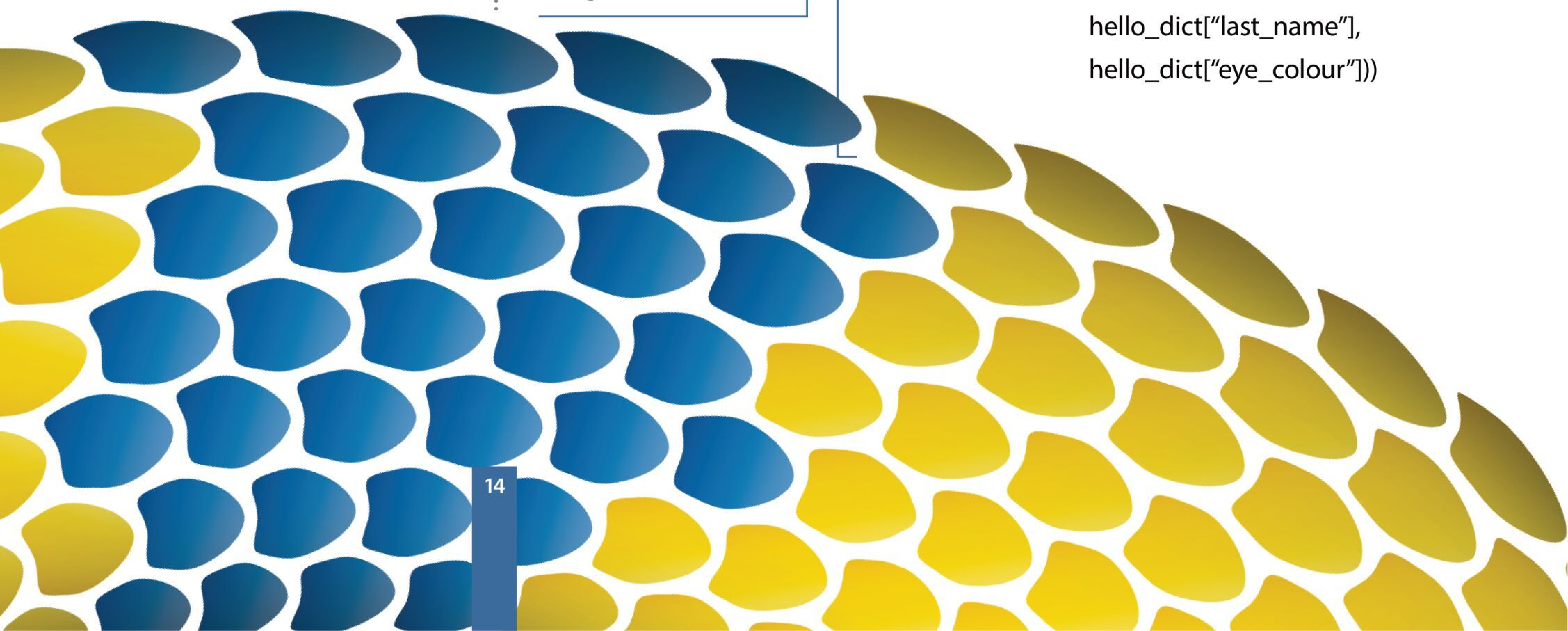
```
print(str(hello_tuple[0]))
# We can't change the value of those elements
like we just did with the list
# Notice the use of the str function above to
explicitly convert the integer
# value inside the tuple to a string before
printing it.
```

Let's create a sentence using the data in our hello_dict

```
print(hello_dict["first_name"] + " " + hello_
dict["last_name"] + " has " +
   hello_dict["eye_colour"] + " eyes.")
```

A much tidier way of doing this would be to use Python's string formatter

```
print("{0} {1} has {2} eyes.".format(hello_
dict["first_name"],
               hello_dict["last_name"],
               hello_dict["eye_colour"]))
```



Indentation in detail

As previously mentioned, the level of indentation dictates which statement a block of code belongs to. Indentation is mandatory in Python, whereas in other languages, sets of braces are used to organise code blocks. For this reason, it is essential to use a consistent indentation style. Four spaces are typically used to represent a single level of indentation in Python. You can use tabs, but tabs are not well defined, especially if you open a file in more than one editor.

Control structures

In programming, a control structure is any kind of statement that can change the path that the code execution takes. For example, a control structure that decided to end the program if a number was less than 5 would look something like this:

```
#!/usr/bin/env python2
import sys # Used for the sys.exit function
int_condition = 5
if int_condition < 6:
    sys.exit(“int_condition must be >= 6”)
else:
    print(“int_condition was >= 6 - continuing”)
```

The path that the code takes will depend on the value of the integer int_condition. The code in the ‘if’ block will only be executed if the condition is true. The import statement is used to load the Python system library; the latter provides the exit function, allowing you to exit the program, printing an error message. Notice that indentation (in this case four spaces per indent) is used to indicate which statement a block of code belongs to. ‘If’ statements are probably the most commonly used control structures. Other control

“The path the code takes will depend on the value of the integer int_condition” structures include: the following items, which you should be aware of when using Python:

- **For statements, which allow you to iterate over items in collections, or to repeat a piece of code again a certain number of times;**
- **While statements, a loop that continues while the condition is true.**

We're going to write a program that accepts user input from the user to demonstrate how control structures work. We're calling it construct.py. The 'for' loop is using a local copy of the current value, which means any changes inside the loop won't make any changes affecting the list. On the other hand however, the 'while' loop is directly accessing elements in the list, so you could change the list there should you want to do so. We will talk about variable scope in some more detail later on in the article. The output from the above program is as follows:

```
[liam@liam-laptop Python]$ ./
construct.py
How many integers? acd
You must enter an integer

[liam@liam-laptop Python]$ ./
construct.py
How many integers? 3
Please enter integer 1: t
You must enter an integer
Please enter integer 1: 5
Please enter integer 2: 2
Please enter integer 3: 6
Using a for loop
5
2
6
Using a while loop
5
2
6
```

"The 'for' loop uses a local copy, so changes in the loop won't affect the list"

Full code listing

```
#!/usr/bin/env python2

# We're going to write a program that will ask the
user to input an arbitrary
# number of integers, store them in a collection,
and then demonstrate how the
# collection would be used with various control
structures.

import sys # Used for the sys.exit
function
```

The number of integers we want in the list

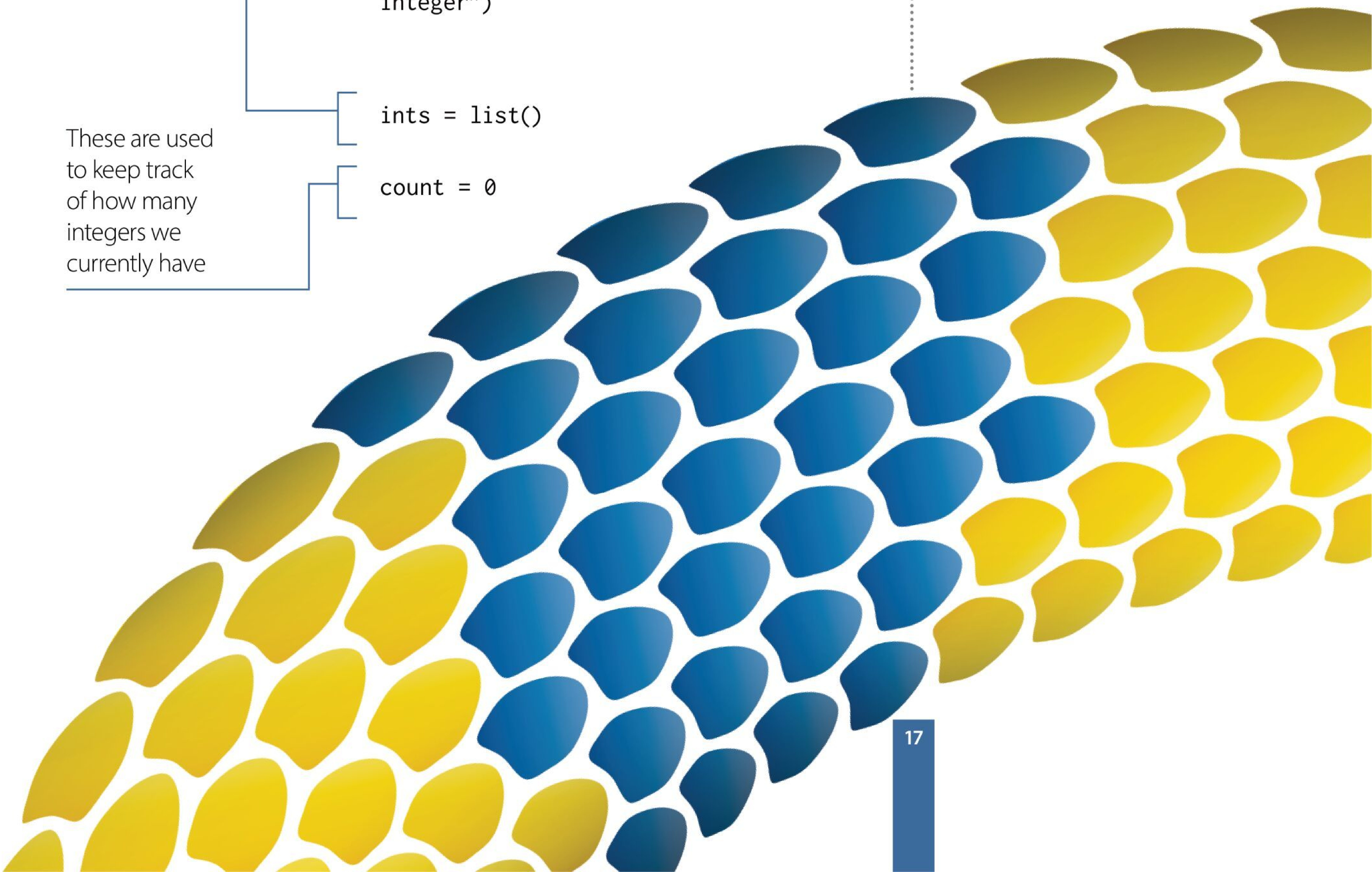
```
target_int = raw_input("How many
integers? ")

# By now, the variable target_int contains a string
representation of
# whatever the user typed. We need to try and
convert that to an integer but
# be ready to # deal with the error if it's not.
Otherwise the program will
# crash.
try:
    target_int = int(target_int)
except ValueError:
    sys.exit("You must enter an
integer")
```

A list to store the integers

```
ints = list()
```

These are used to keep track of how many integers we currently have

```
count = 0
```



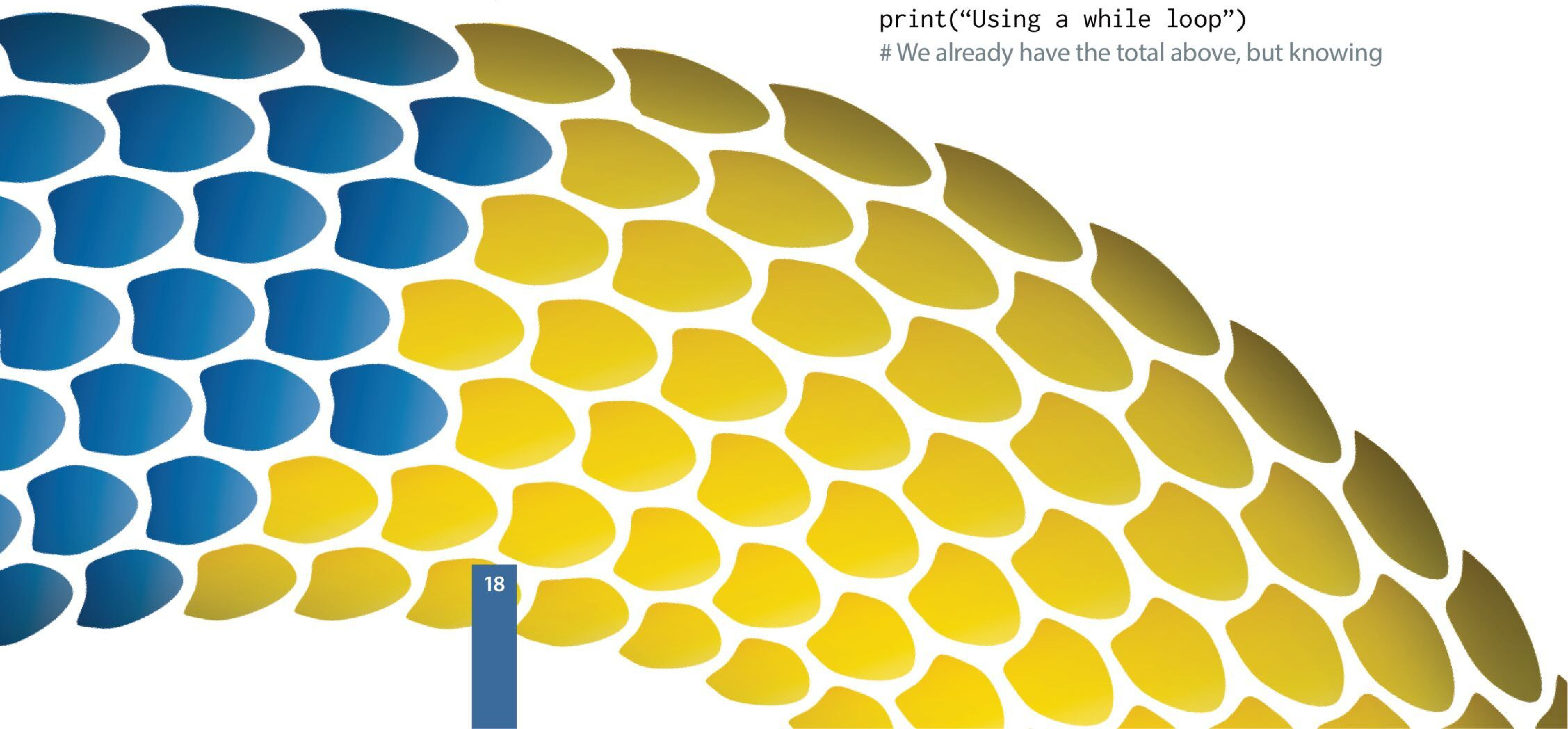
Get started with Python

If the above succeeds then isint will be set to true: isint =True

```
# Keep asking for an integer until we have the
required number
while count < target_int:
    new_int = raw_input("Please enter
integer {0}: ".format(count + 1))
    isint = False
    try:
        new_int = int(new_int)

    except:
        print("You must enter an
integer")

  # Only carry on if we have an integer. If not,
we'll loop again
  # Notice below I use ==, which is different from
  =. The single equals is an
  # assignment operator whereas the double
  equals is a comparison operator.

    if isint == True:
     # Add the integer to the collection
      ints.append(new_int)
    # Increment the count by 1
        count += 1
```

By now, the user has given up or we have a list filled with integers. We can loop through these in a couple of ways. The first is with a for loop

```
print("Using a for loop")
for value in ints:
    print(str(value))

# Or with a while loop:
print("Using a while loop")
# We already have the total above, but knowing
```



```
the len function is very
# useful.
total = len(ints)
count = 0
while count < total:
    print(str(ints[count]))
    count += 1
```

More about a Python list

A Python list is similar to an array in other languages. A list (or tuple) in Python can contain data of multiple types, which is not usually the case with arrays in other languages. For this reason, we recommend that you only store data of the same type in a list. This should almost always be the case anyway due to the nature of the way data in a list would be processed.

Functions and variable scope

Functions are used in programming to break processes down into smaller chunks. This often makes code much easier to read. Functions can also be reusable if designed in a certain way. Functions can have variables passed to them. Variables in Python are always passed by value, which means that a copy of the variable is passed to the function that is only valid in the scope of the function. Any changes made to the original variable inside the function will be discarded. However, functions can also return values, so this isn't an issue. Functions are defined with the keyword def, followed by the name of the function. Any variables that can be passed through are put in brackets following the function's name. Multiple variables are separated by commas. The names given to the variables in these brackets are the ones that they will have in the scope of the function, regardless of what the variable that's passed to the function is called.

Let's see this in action. The output from the program opposite is as follows:

> "Functions are defined with the keyword def, then the name of the function"

Get started with Python

```
#!/usr/bin/env python2 # Below is a function
called modify_string, which accepts a variable
# that will be called original in the scope of the
function. Anything # indented with 4 spaces
under the function definition is in the
# scope.
def modify_string(original):
    original += " that has been
modified."
   # At the moment, only the local copy of this
string has been modified

def modify_string_return(original):
    original += " that has been
modified."
   # However, we can return our local copy to the
caller. The function# ends as soon as the return
statement is used, regardless of where it # is in
the function.
    return original
```

We are now outside of the scope of the modify_string function, as we have reduced the level of indentation

```
test_string = "This is a test string"
```

The test string won't be changed in this code

```
modify_string(test_string)
print(test_string)
```

However, we can call the function like this

```
test_string = modify_string_
return(test_string)
print(test_string)

# The function's return value is stored in the
variable test string, # overwriting the original and
therefore changing the value that is # printed.
```

```
[liam@liam-laptop Python]$ ./functions_and_
scope.py
This is a test string
This is a test string that has been modified.
```

Scope is an important thing to get the hang of, otherwise it can get you into some bad habits. Let's write a quick program to demonstrate this. It's going to have a Boolean variable called cont, which will decide if a number will be assigned to a variable in an if statement. However, the variable hasn't been defined anywhere apart from in the scope of the if statement. We'll finish off by trying to print the variable.

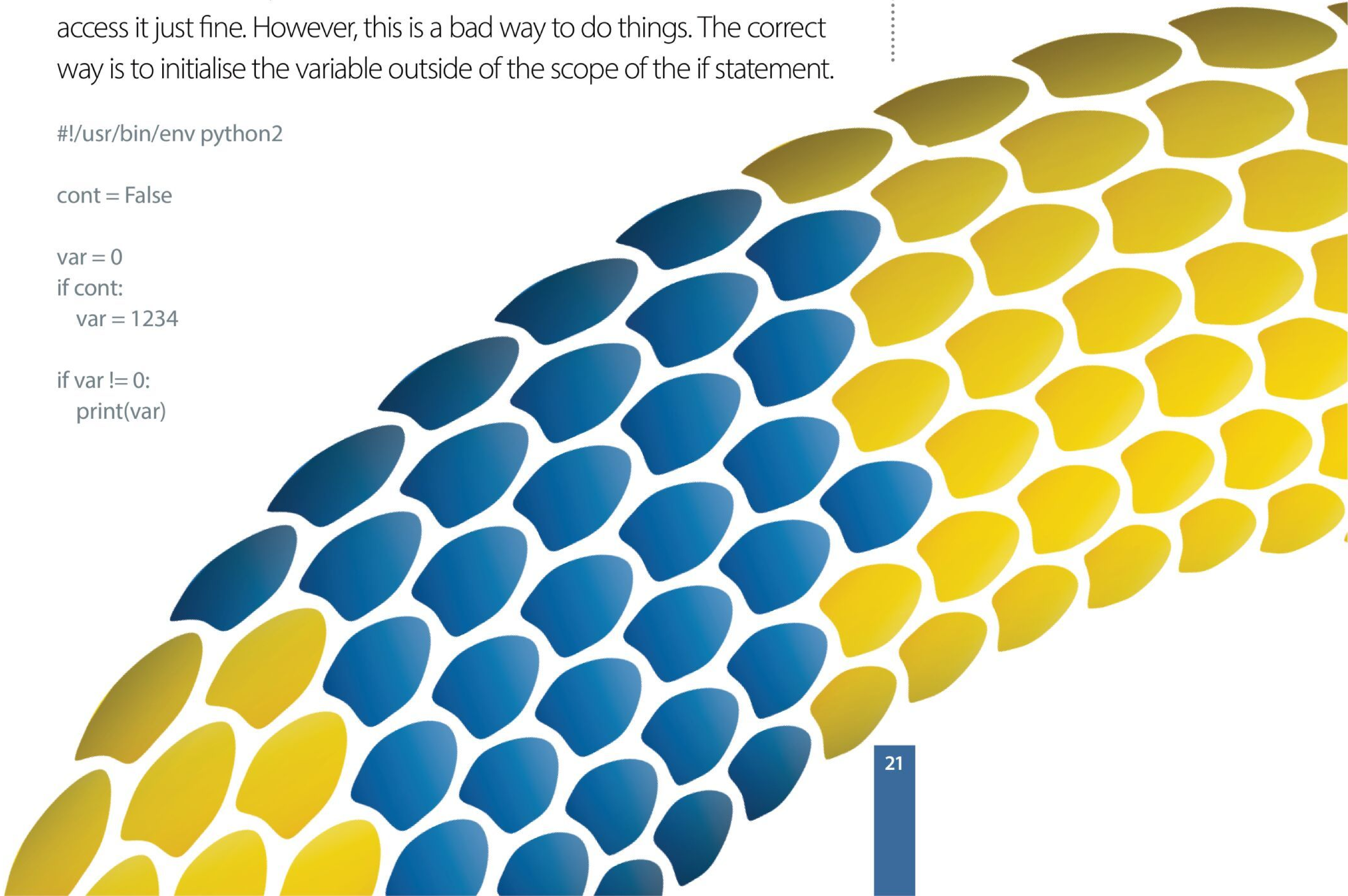
```
#!/usr/bin/env python2
cont = False
if cont:
    var = 1234
print(var)
```

In the section of code above, Python will convert the integer to a string before printing it. However, it's always a good idea to explicitly convert things to strings – especially when it comes to concatenating strings together. If you try to use the + operator on a string and an integer, there will be an error because it's not explicitly clear what needs to happen. The + operator would usually add two integers together. Having said that, Python's string formatter that we demonstrated earlier is a cleaner way of doing that. Can you see the problem? Var has only been defined in the scope of the if statement. This means that we get a very nasty error when we try to access var.

```
[liam@liam-laptop Python]$ ./scope.py
Traceback (most recent call last):
  File "./scope.py", line 8, in <module>
    print var
NameError: name 'var' is not defined
```

If cont is set to True, then the variable will be created and we can access it just fine. However, this is a bad way to do things. The correct way is to initialise the variable outside of the scope of the if statement.

```
#!/usr/bin/env python2

cont = False

var = 0
if cont:
    var = 1234

if var != 0:
    print(var)
```



Tip

You can define defaults for variables if you want to be able to call the function without passing any variables through at all. You do this by putting an equals sign after the variable name. For example, you can do:
def modify_string (original=" Default String")

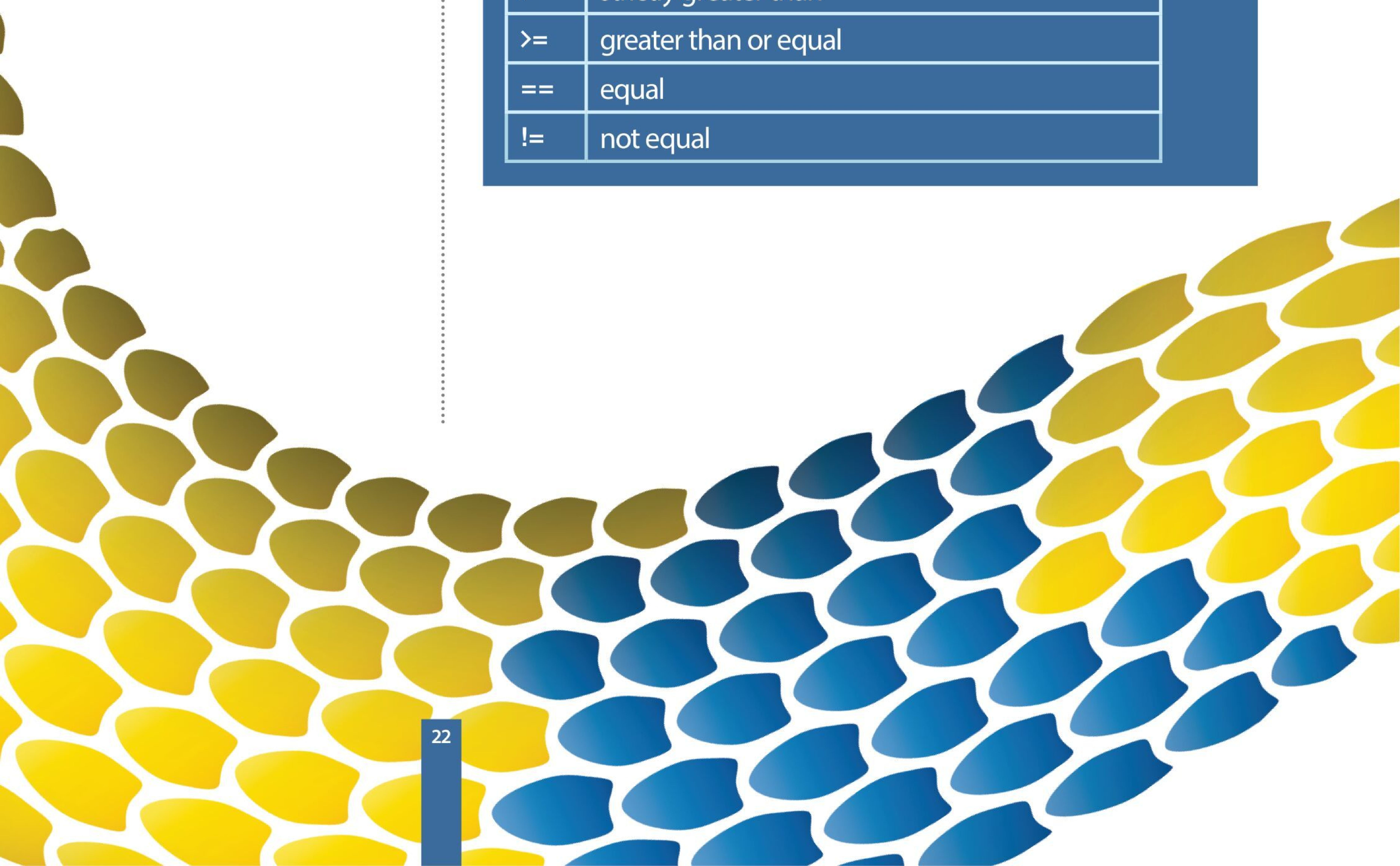
The variable var is defined in a wider scope than the if statement, and can still be accessed by the if statement. Any changes made to var inside the if statement are changing the variable defined in the larger scope. This example doesn't really do anything useful apart from illustrate the potential problem, but the worst-case scenario has gone from the program crashing to printing a zero. Even that doesn't happen because we've added an extra construct to test the value of var before printing it.

> "Google, or any other search engine, is very helpful if you are stuck with anything, or have an error message you can't work out how to fix"

Comparison operators

The common comparison operators available in Python include:

<	strictly less than
<=	less than or equal
>	strictly greater than
>=	greater than or equal
==	equal
!=	not equal

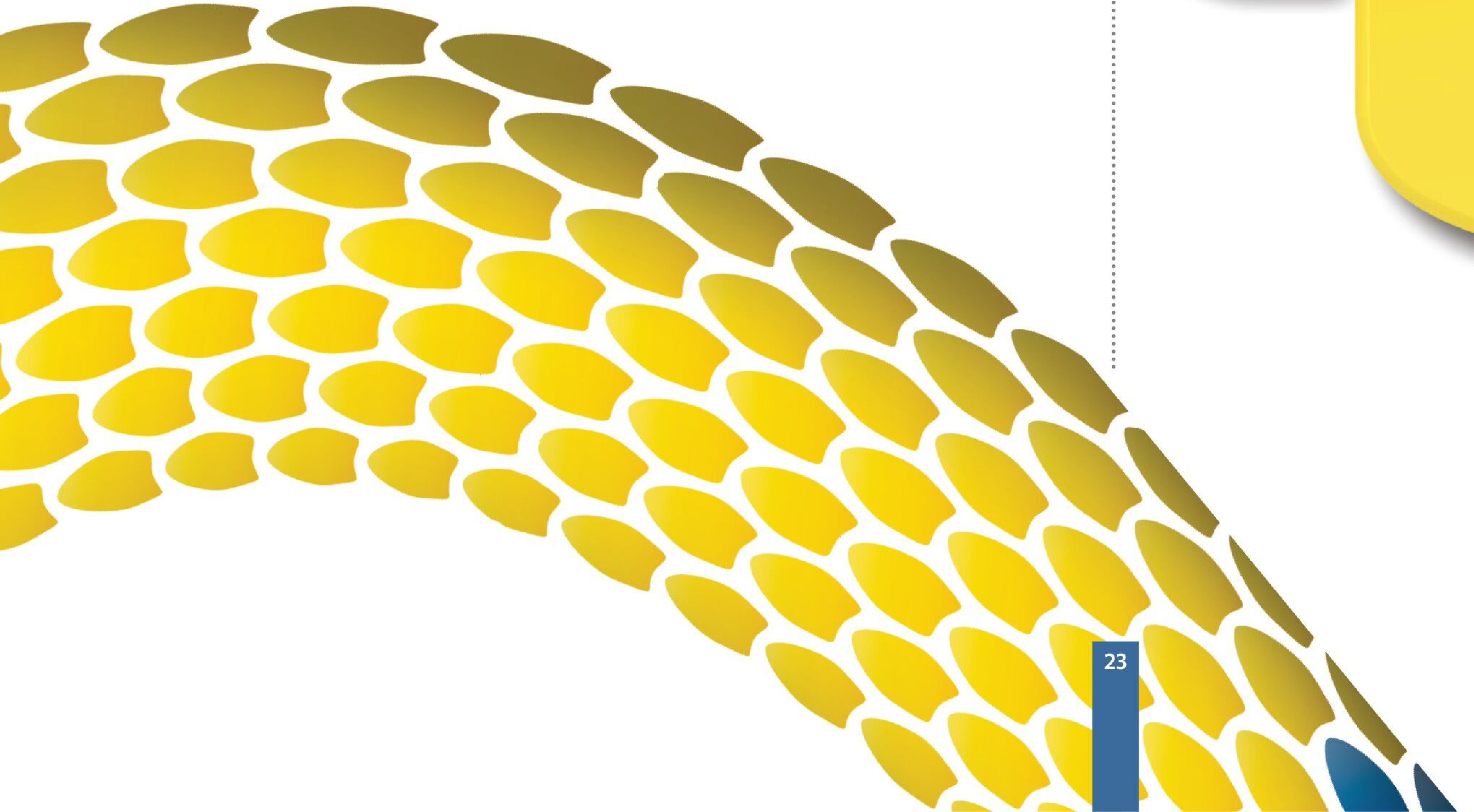


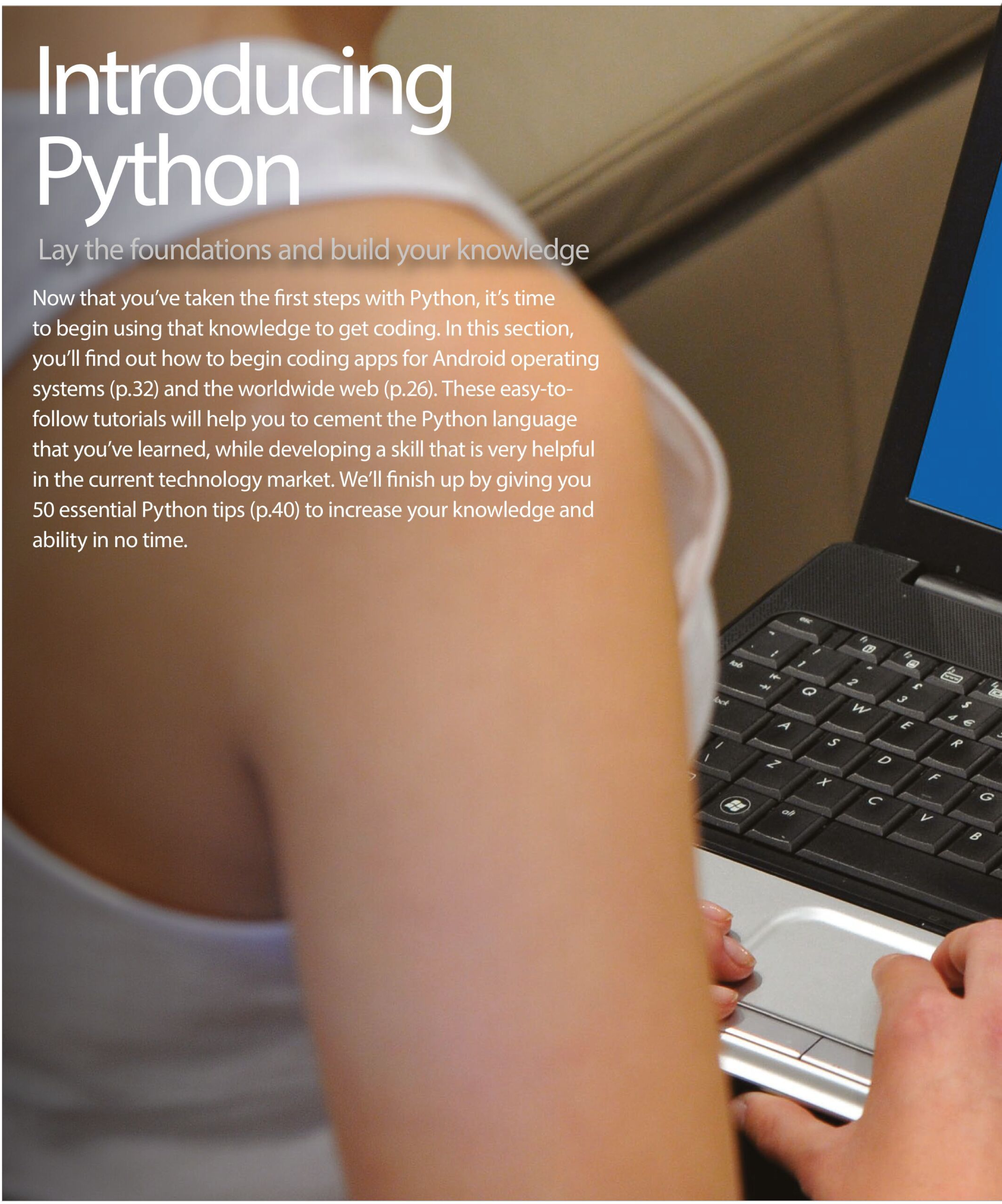
Coding style

It's worth taking a little time to talk about coding style. It's simple to write tidy code. The key is consistency. For example, you should always name your variables in the same manner. It doesn't matter if you want to use camelCase or use underscores as we have. One crucial thing is to use self-documenting identifiers for variables. You shouldn't have to guess what a variable does. The other thing that goes with this is to always comment your code. This will help anyone else who reads your code, and yourself in the future. It's also useful to put a brief summary at the top of a code file describing what the application does, or a part of the application if it's made up of multiple files.

Summary

This article should have introduced you to the basics of programming in Python. Hopefully you are getting used to the syntax, indentation and general look and feel of a Python program. The next step is to learn how to come up with a problem that you want to solve, and break it down into small steps that you can implement in a programming language. Google, or any other search engine, is very helpful. If you are stuck with anything, or have an error message you can't work out how to fix, stick it into Google and you should be a lot closer to solving your problem. For example, if we Google 'play mp3 file with python', the first link takes us to a Stack Overflow thread with a bunch of useful replies. Don't be afraid to get stuck in – the real fun of programming is solving problems one manageable chunk at a time.





Introducing Python

Lay the foundations and build your knowledge

Now that you've taken the first steps with Python, it's time to begin using that knowledge to get coding. In this section, you'll find out how to begin coding apps for Android operating systems (p.32) and the worldwide web (p.26). These easy-to-follow tutorials will help you to cement the Python language that you've learned, while developing a skill that is very helpful in the current technology market. We'll finish up by giving you 50 essential Python tips (p.40) to increase your knowledge and ability in no time.

Django administration

Home › Ludissues › Issues

Welcome, max. Change password / Log out

Select issue to change

Search

‹ 2013 February 15 February 16 February 20

Action: --------- Go 0 of 5 selected

ID	Name	Status	Owner	Date modified
1	There is a problem in that module.	New	max	Feb. 16, 2013, 1:56 a.m.
2	Internet is not able to connect on the mars server.	Accepted	ana	Feb. 16, 2013, 3:46 a.m.
3	galactic federation has some issues with Star Wars accuracy	Started	samfisher	Feb. 15, 2013, 11:46 a.m.
4	Moving stairs are stuck again. This is the third time it happened today.	Started	dumbledore	Feb. 20, 2013, 5 p.m.
5	Three cells are missing from splinter cell torch	Started	samfisher	Feb. 20, 2013, 2:10 a.m.

5 issues

Add issue
Filter
By status
All
New
Accepted
Reviewed
Started
Closed
By owner
All
max
ana
lin
dumbledore
samfisher
(None)

Django administration

Welcome, max. Change passwor

Site administration

Auth
Groups Add Change
Users Add Change
Ludissues
Issues Add Change
Sites
Sites Add Change
Recent Actions
My Actions

None available

Django administration

Home › Ludissues › Issues › Add issue

Add issue

Owner: ---------

max
mcdza
allen
danwest

Status:

Summary:

What you'll need…

Python 2.7:
https://www.python.org/download/releases/2.7/

Django version 1.4:
https://www.djangoproject.com/

Make web apps with Python

Python provides quick and easy way to build applications, including web apps. Find out how to use it to build a feature-complete web app

Python is known for its simplicity and capabilities. At this point it is so advanced that there is nothing you cannot do with Python, and conquering the web is one of the possibilities. When you are using Python for web development you get access to a huge catalogue of modules and community support – make the most of them.

Web development in Python can be done in many different ways, right from using the plain old CGI modules to utilising fully groomed web frameworks. Using the latter is the most popular method of building web applications with Python, since it allows you to build applications without worrying about all that low-level implementation stuff. There are many web frameworks available for Python, such as Django, TurboGears and Web2Py. For this tutorial we will be using our current preferred option, Django.

The Django Project magazine issue tracker

01 The django-admin.py file is used to create new Django projects. Let's create one for our issue tracker project here…

In Django, a project represents the site and its settings. An application, on the other hand, represents a specific feature of the site, like blogging or tagging. The benefit of this approach is that your Django application becomes portable and can be integrated with other Django sites with very little effort.

```
$ django-admin.py startproject
ludIssueTracker
```

A project directory will be created. This will also act as the root of your development web server that comes with Django. Under the project directory you will find the following items…

manage.py: Python script to work with your project.

ludIssueTracker: A python package (a directory with __init__.py file) for your project. This package is the one containing your project's settings and configuration data.

ludIssueTracker/settings.py: This file contains all the configuration options for the project.

ludIssueTracker/urls.py: This file contains various URL mappings.

wsgi.py: An entry-point for WSGI-compatible web servers to serve your project. Only useful when you are deploying your project. For this tutorial we won't be needing it.

Configuring the Django project

02 Before we start working on the application, let's configure the Django project as per our requirements.

Edit ludIssueTracker/settings.py as follows (only parts requiring modification are shown):

Database Settings: We will be using SQLite3 as our database system here.

NOTE: Red text indicates new code or updated code.

```
'default': {
        'ENGINE':
'django.db.backends.
sqlite3',
        'NAME': 'ludsite.
db3,
```

Path settings

Django requires an absolute path for directory settings. But we want to be able to pass in the relative directory references. In order to do that we will add a helper Python function. Insert the following code at the top of the settings.py file:

```
import os
def getabspath(*x):
 return os.path.join(os.
path.abspath(os.path.
dirname(__file__)), *x)
```

Now update the path options:

```
@code
TEMPLATE_DIRS = (
 getabspath('templates')
)
MEDIA_ROOT =
getabspath('media')
MEDIA_URL = '/media/'
```

Now we will need to enable the admin interface for our Django site. This is a neat feature of Django which allows automatic creation of an admin interface of the site based on the data model. The admin interface can be used to add and manage content for a Django site.

Uncomment the following line:

```
INSTALLED_APPS = (


    'django.contrib.auth',
    'django.contrib.
contenttypes',
    'django.contrib.sessions',
    'django.contrib.sites',
   'django.contrib.messages',
    'django.contrib.
staticfiles',
    'django.contrib.admin',
    # 'django.contrib.
admindocs',
)
```

Creating ludissues app

03 In this step we will create the primary app for our site, called ludissues. To do that, we will use the manage.py script:

```
$ python manage.py startapp
ludissues
```

We will need to enable this app in the config file as well:

```
INSTALLED_APPS = (
    ............
    'django.contrib.admin',
    'ludissues',
)
```

Creating the data model

04 This is the part where we define the data model for our app. Please see the inline comments to understand what is happening here.

From django.db import models:

```
# We are importing the
user authentication module so
that we use the built
# in authentication model
in this app
from django.contrib.auth.
models import User
# We would also create an
admin interface for our app
from django.contrib import
admin

# A Tuple to hold the
multi choice char fields.
# First represents the
field name the second one
repersents the display name
ISSUE_STATUS_CHOICES = (
    ('new', 'New'),
    ('accepted','Accepted'),
    ('reviewed','Reviewed'),
    ('started','Started'),
    ('closed','Closed'),
)
```

> "When you are using Python for web development you get access to a huge catalogue of modules and support"

```
class Issue(models.Model):
     # owner will be a
foreign key to the User
model which is already built-
in Django
     owner = models.ForeignKe
y(User,null=True,blank=True)
     # multichoice with
defaulting to “new”
     status = models.
CharField(max_
length=25,choices=ISSUE_
STATUS_CHOICES,default=’new’)
     summary = models.
TextField()
     # date time field which
will be set to the date time
when the record is created
     opened_on = models.
DateTimeField(‘date opened’,
auto_now_add=True)
     modified_on = models.
DateTimeField(‘date modified’,
auto_now=True)

     def name(self):
          return self.summary.
split(‘\n’,1)[0]

# Admin front end for the
app. We are also configuring
some of the
# built in attributes for
the admin interface on
# how to display the list,
how it will be sorted
# what are the search
fields etc.
class IssueAdmin(admin.
ModelAdmin):
     date_hierarchy =
‘opened_on’
     list_filter =
(‘status’,’owner’)
     list_display = (‘id’,’n
ame’,’status’,’owner’,’modifi
ed_on’)
     search_fields =
[‘description’,’status’]

# register our site with
the Django admin interface
admin.site.
register(Issue,IssueAdmin)
```

To have the created data model reflected in the database, run the following command:

```
$ python manage.py syncdb
```

You'll be also asked to create a superuser for it:

```
You just installed Django’s auth
system, which means you don’t
have any superusers defined.
Would you like to create one
now? (yes/no): yes
```

Enabling the admin site

05 The admin site is already enabled, but we need to enable it in the urls.py file – this contains the regex-based URL mapping from model to view. Update the urls.py file as follows:

```
from django.conf.urls import
patterns, include, url
from django.contrib import
admin
admin.autodiscover()

urlpatterns = patterns(‘’,
    url(r’^admin/’,
include(admin.site.urls)),
)
```

Starting the Django web server

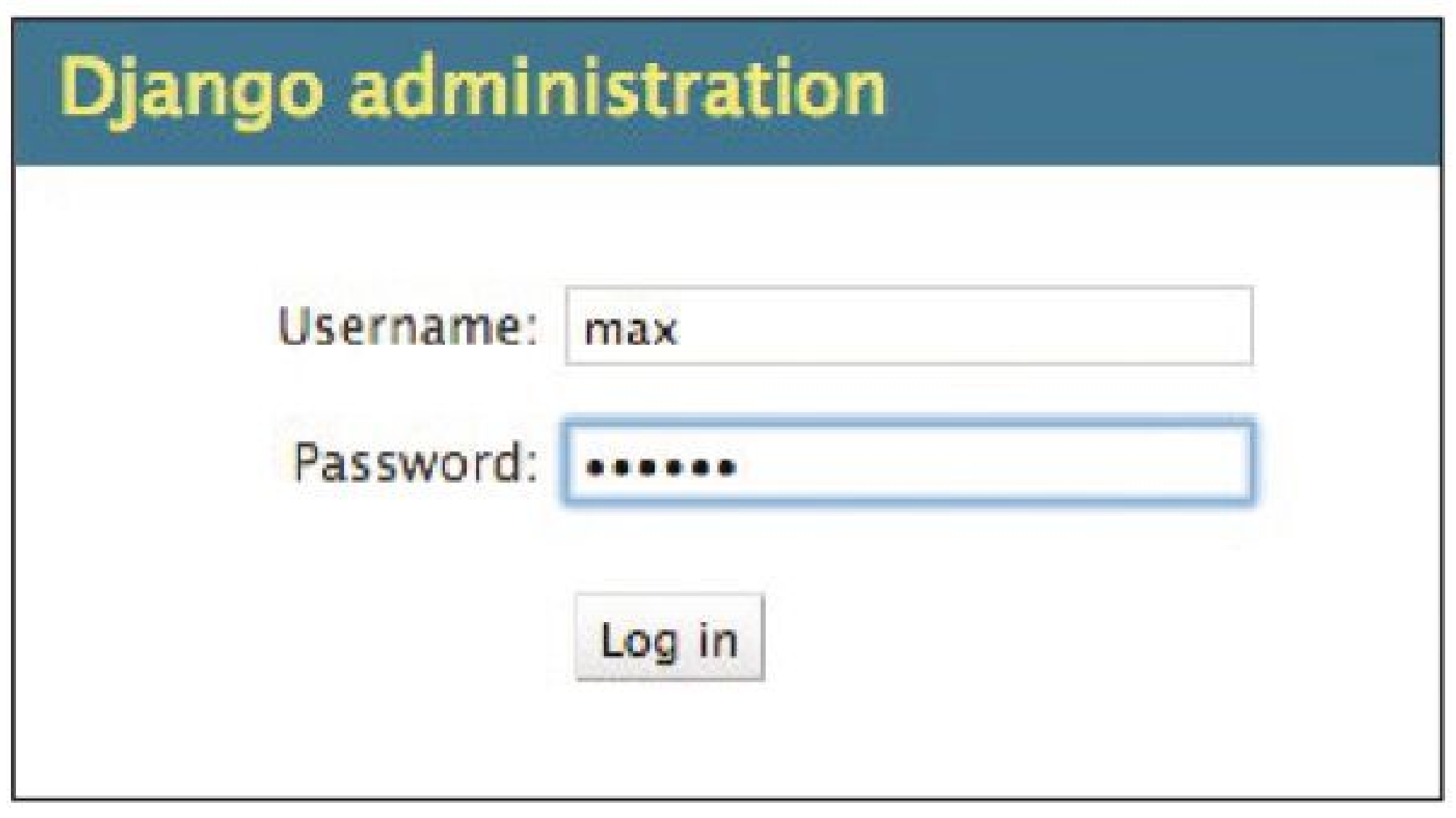
06 Django includes a built-in web server which is very handy to debug and test Django applications. Let's start it to see how our admin interface works…

To start the web server:

```
$ python manage.py
runserver
```

If you do not have any errors in your code, the server should be available on port 8000. To launch the admin interface, navigate your browser to http://localhost:8000/admin.

You will be asked to log in here. Enter the username and password that you created while you were syncing the database.



Django administration

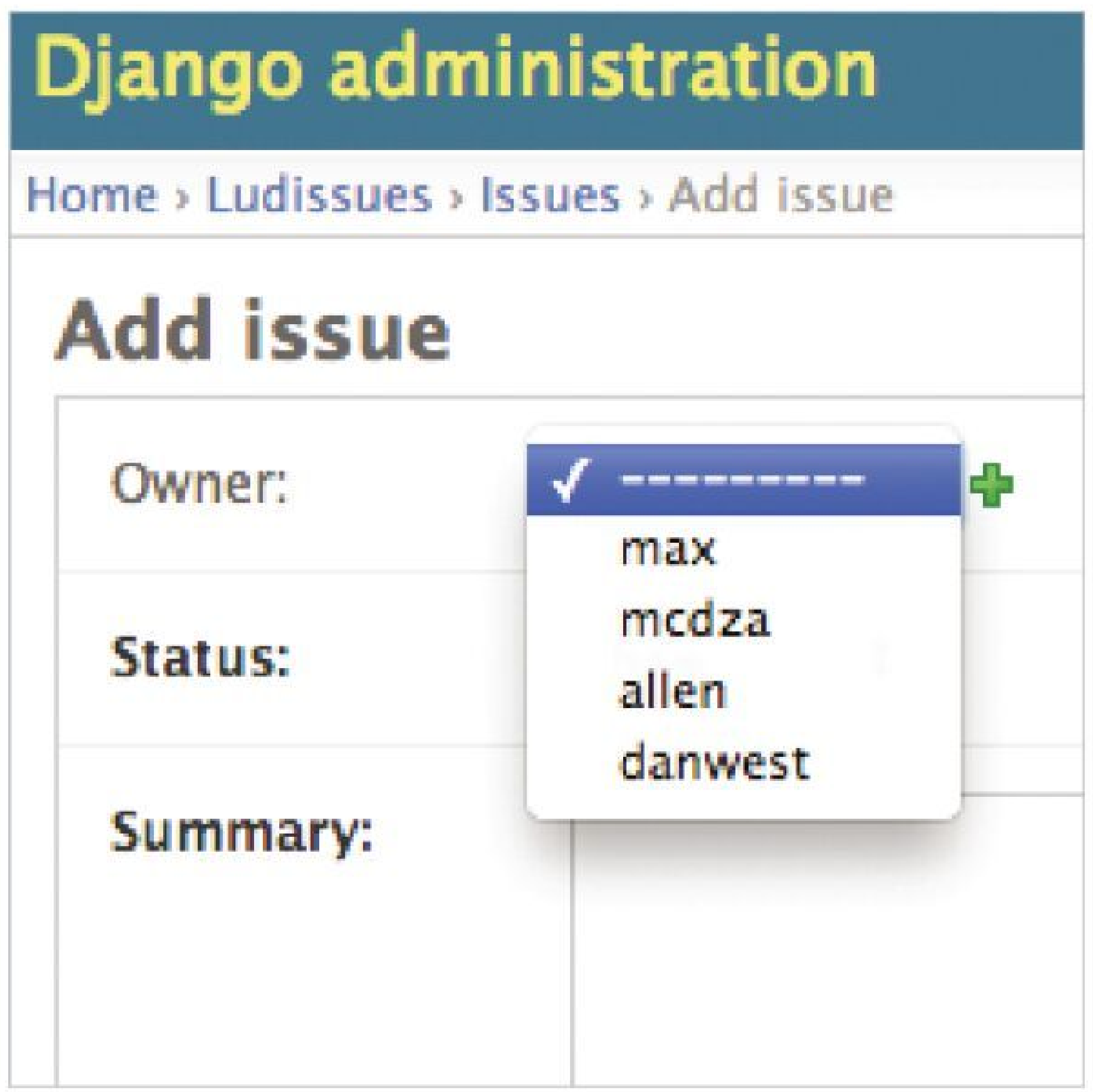
Username: max

Password: ••••••

After logging in, you will notice that all the apps installed in your project are available here. We are only interested in the Auth and LudIssues app.

You can click the +Add to add a record. Click the Add button next to Users and add a few users to the site.

Once you have the users inside the system, you can now add a few issues to the system.



Django administration

Home › Ludissues › Issues › Add issue

Add issue

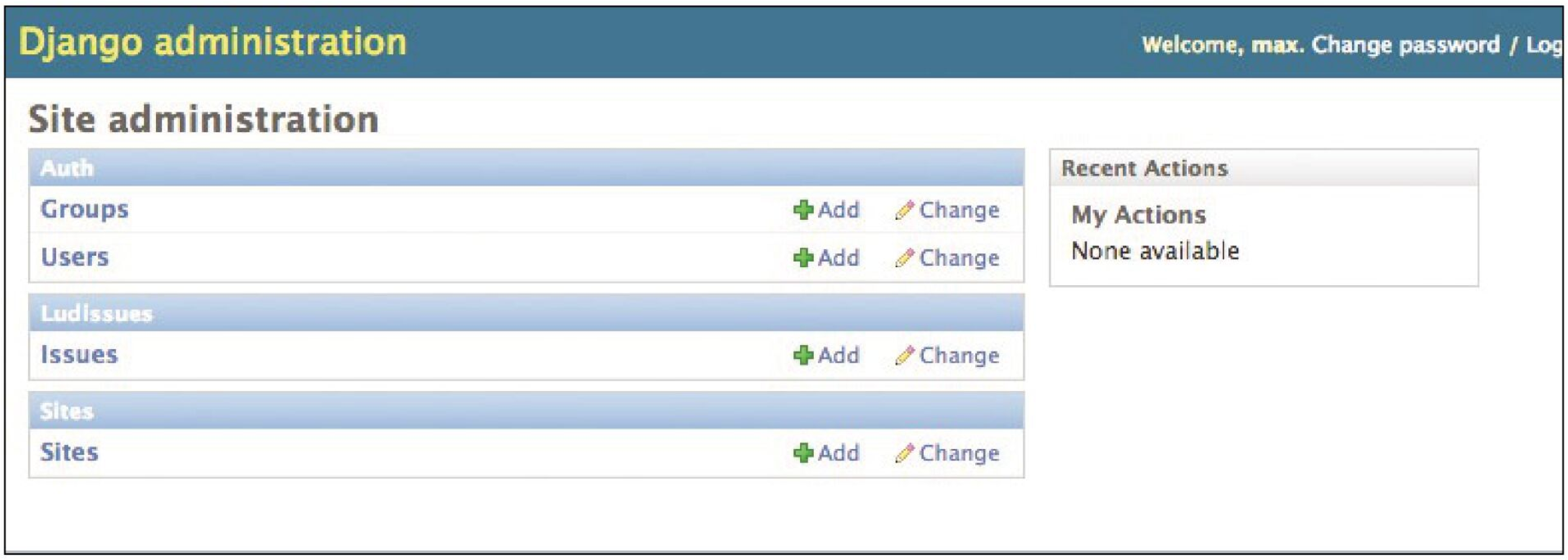
Owner: ✓ ---------
max
mcdza
allen
danwest

Status:

Summary:

Click the Add button next to Issues. Here you will notice that you can enter Owner, Status and Summary for the issue. But what about the opened_on and modified_on field that we

> “It's great that the owner field is automatically populated with details of the users inside the site”



Django administration Welcome, max. Change password / Log

Site administration

Auth
- Groups ✚Add ✎Change
- Users ✚Add ✎Change

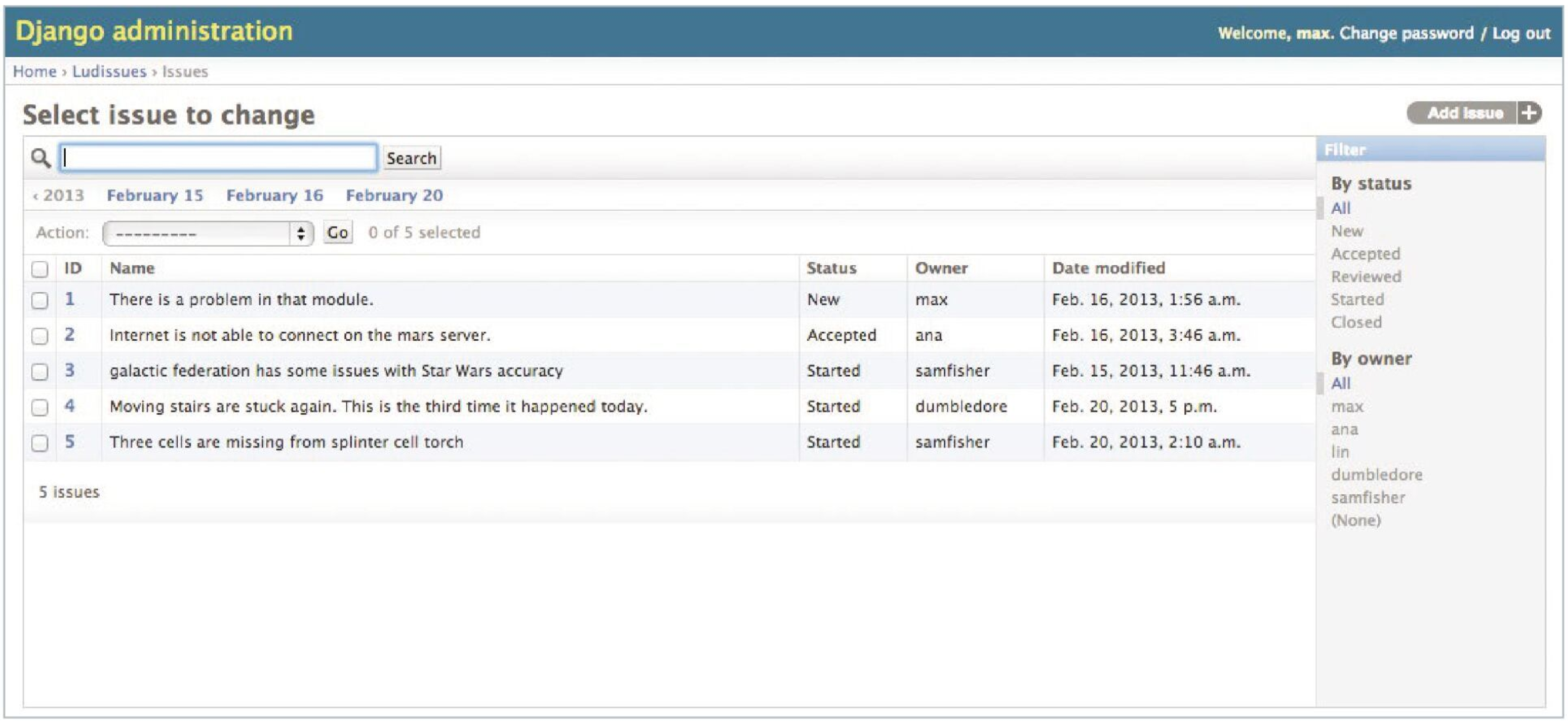
Ludissues
- Issues ✚Add ✎Change

Sites
- Sites ✚Add ✎Change

Recent Actions

My Actions

None available



Django administration Welcome, max. Change password / Log out

Home › Ludissues › Issues

Select issue to change

‹ 2013 February 15 February 16 February 20

Action: --------- Go 0 of 5 selected

☐	ID	Name	Status	Owner	Date modified
☐	1	There is a problem in that module.	New	max	Feb. 16, 2013, 1:56 a.m.
☐	2	Internet is not able to connect on the mars server.	Accepted	ana	Feb. 16, 2013, 3:46 a.m.
☐	3	galactic federation has some issues with Star Wars accuracy	Started	samfisher	Feb. 15, 2013, 11:46 a.m.
☐	4	Moving stairs are stuck again. This is the third time it happened today.	Started	dumbledore	Feb. 20, 2013, 5 p.m.
☐	5	Three cells are missing from splinter cell torch	Started	samfisher	Feb. 20, 2013, 2:10 a.m.

5 issues

Filter

By status
All
New
Accepted
Reviewed
Started
Closed

By owner
All
max
ana
lin
dumbledore
samfisher
(None)

defined while modelling the app? They are not here because they are not supposed to be entered by the user. opened_on will automatically set to the date time it is created and modified_on will automatically set to the date time on which an issue is modified.

Another cool thing is that the owner field is automatically populated with all the users inside the site.

We have defined our list view to show ID, name, status, owner and 'modified on' in the model. You can get to this view by navigating to http://localhost:8000/admin/ludissues/issue/.

Creating the public user interface for ludissues

07 At this point, the admin interface is working. But we need a way to display the data that we have added using the admin interface. But there is no public interface. Let's create it now.

We will have to begin by editing the main urls.py (ludIssueTracker/urls.py).

```
urlpatterns = patterns(‘’,

(r’^’,include(‘ludissues.urls’)),
    (r’^admin/’,
include(admin.site.urls)),
)
```

This ensures that all the requests will be processed by ludissues.urls first.

Creating ludissues.url

08 Create a urls.py file in the app directory (ludissues/urls.py) with the following content:

```
from django.conf.urls import patterns, include, url
# use ludissues model
from models import ludissues

# dictionary with all the
```

```
objects in ludissues
info = {
     ‘queryset’:ludissues.
objects.all(),
}

 # To save us writing lots of
python code
 # we are using the list_
detail generic view

 #list detail is the name of
view we are using
 urlpatterns =
patterns(‘django.views.generic.
list_detail’,
 #issue-list and issue-detail
are the template names
 #which will be looked in the
default template
#directories
     url(r’^$’,’object_
list’,info,name=’issue-list’),
     url(r’^(?P<object_
id>\d+)/$’,’object_
detail’,info,name=’issue-detail’),

)
```

To display an issue list and details, we are using a Django feature called generic views. In this case we are using views called list and details. This allow us to create an issue list view and issue detail view. These views are then applied using the issue_list.html and issue_detail.html template. In the following steps we will create the template files.

Setting up template and media directories

09 In this step we will create the template and media directories. We have already mentioned the template directory as

```
TEMPLATE_DIRS = (
    getabspath(‘templates’)
)
```

Which translates to ludIssueTracker/ludIssueTracker/templates/. Since we will be accessing the templates from the ludissues app, the complete directory path would be ludIssueTracker/ludIssueTracker/templates/ludissues. Create these folders in your project folder.

Also, create the directory ludIssueTracker/ludIssueTracker/media/ for holding the CSS file. Copy the style.css file from the resources directory of the code folder. To serve files from this folder, make it available publicly. Open settings.py and add these lines in ludIssueTracker/ludIssueTracker/urls.py:

```
 from django.conf.urls import
patterns, include, url
 from django.conf import
settings
 # Uncomment the next two
lines to enable the admin:
 from django.contrib import
admin
admin.autodiscover()

 urlpatterns = patterns(‘’,
     (r’^’,include(‘ludissues.
urls’)),
     (r’^admin/’, include(admin.
site.urls)),
     (r’^media/
(?P<path>.*)$’,’django.views.
static.serve’,
      {‘document_root’:settings.
MEDIA_ROOT})
)
```

Creating the template files

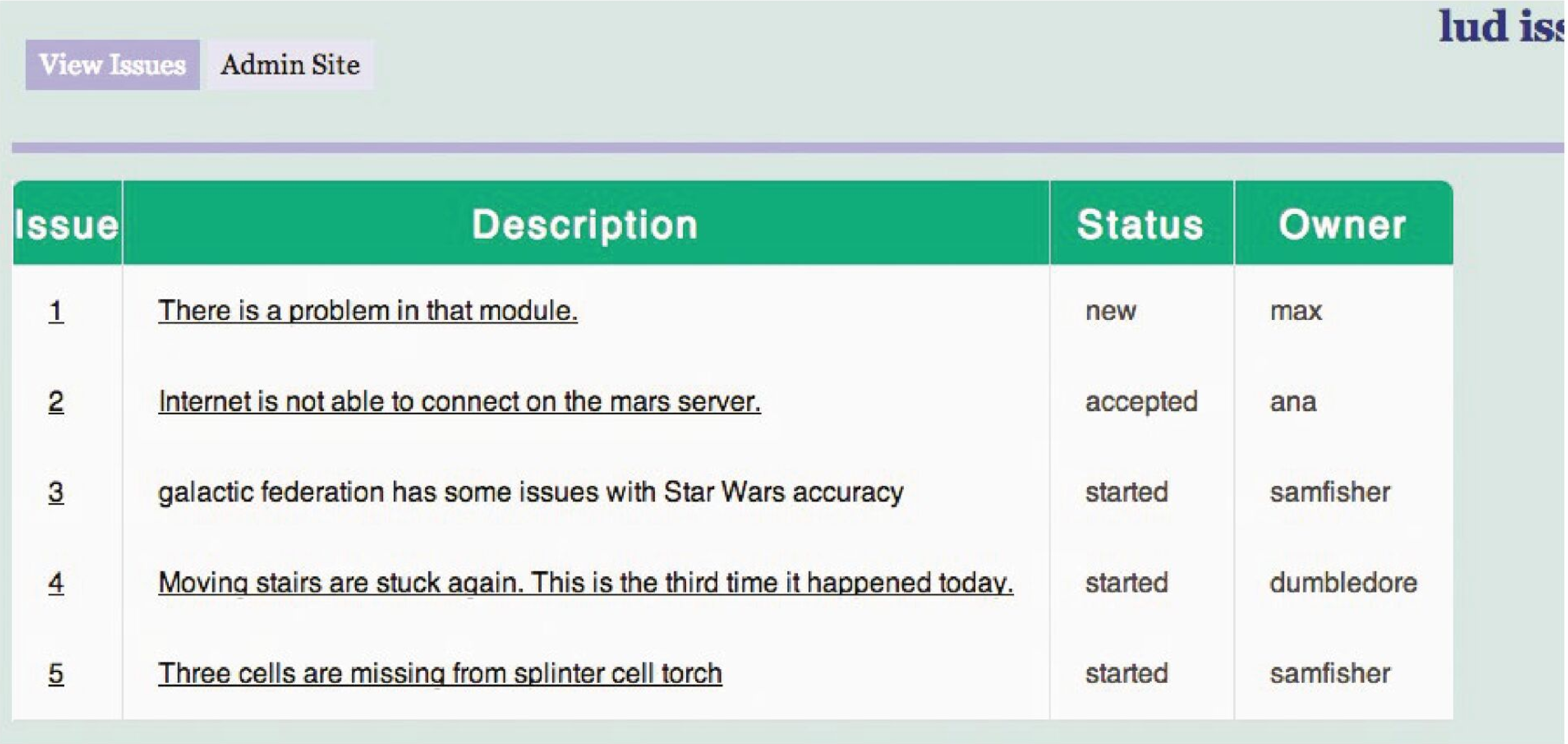
10 Templates will be loaded from the ludIssueTracker/ludIssueTracker/templates directory.

In Django, we start with the ludIssueTracker/ludIssueTracker/templates/base.html template. Think of it as the master template which can be inherited by slave ones.

ludIssueTracker/ludIssueTracker/templates/base.html

```
 <!DOCTYPE html PUBLIC “-//
W3C//DTD XHTML Strict//EN”
 “ HYPERLINK “http://www.
w3.org/TR/xhtml1/DTD/xhtml1-
strict.dtd” http://www.w3.org/TR/
xhtml1/DTD/xhtml1-strict.dtd”>
 <html>
          <head>
          <title>{% block title
%}{% endblock %}LUD Issues</
title>
          <link rel=”stylesheet”
href=”{{ MEDIA_URL }}style.css”
type=”text/css” media=”screen”
/>
</head>
<body>
          <div id=”hd”>
                    <h1>LUD
Issue Tracker</span></h1>
          </div>
          <div id=”mn”>
                    <ul>

<li><a href=”{% url issue-list
%}” class=”sel”>View Issues</
a></li>

<li><a href=”/admin/”>Admin
Site</a></li>
                    </ul>
          </div>
          <div id=”bd”>
                    {% block
content %}{% endblock %}
          </div>
</body>
 </html>
```

> ”To display an issue list and details here, we are using a Django feature called generic views”



Issue	Description	Status	Owner
1	There is a problem in that module.	new	max
2	Internet is not able to connect on the mars server.	accepted	ana
3	galactic federation has some issues with Star Wars accuracy	started	samfisher
4	Moving stairs are stuck again. This is the third time it happened today.	started	dumbledore
5	Three cells are missing from splinter cell torch	started	samfisher

{{ variablename }} represents a Django variable.

(% block title %} represents blocks. Contents of a block are evaluated by Django and are displayed. These blocks can be replaced by the child templates.

Now we need to create the issue_list.html template. This template is responsible for displaying all the issues available in the system.

ludIssueTracker/ludIssueTracker/templates/ludissues/issue_list.html

```
{% extends ‘base.html’ %}
{% block title %}View Issues - {% endblock %}
{% block content %}
<table cellspacing=”0” class=”column-options”>
        <tr>
        <th>Issue</th>
        <th>Description</th>
        <th>Status</th>
        <th>Owner</th>
        </tr>
        {% for issue in object_list %}
        <tr>
        <td><a href=”{% url issue-detail issue.id %}”>{{ issue.id }}</a></td>
        <td><a href=”{% url issue-detail issue.id %}”>{{ issue.name }}</a></td>
        <td>{{ issue.status }}</td>
        <td>{{ issue.owner}}</td>
        </tr>
        {% endfor %}
</table>
{% endblock %}
```

Here we are inheriting the base.html file that we created earlier. {% for issue in object_list %} runs on the object sent by the urls.py. Then we are iterating on the object_list for issue.id and issue.name.

Now we will create issue_detail.html. This template is responsible for displaying the detail view of a case.

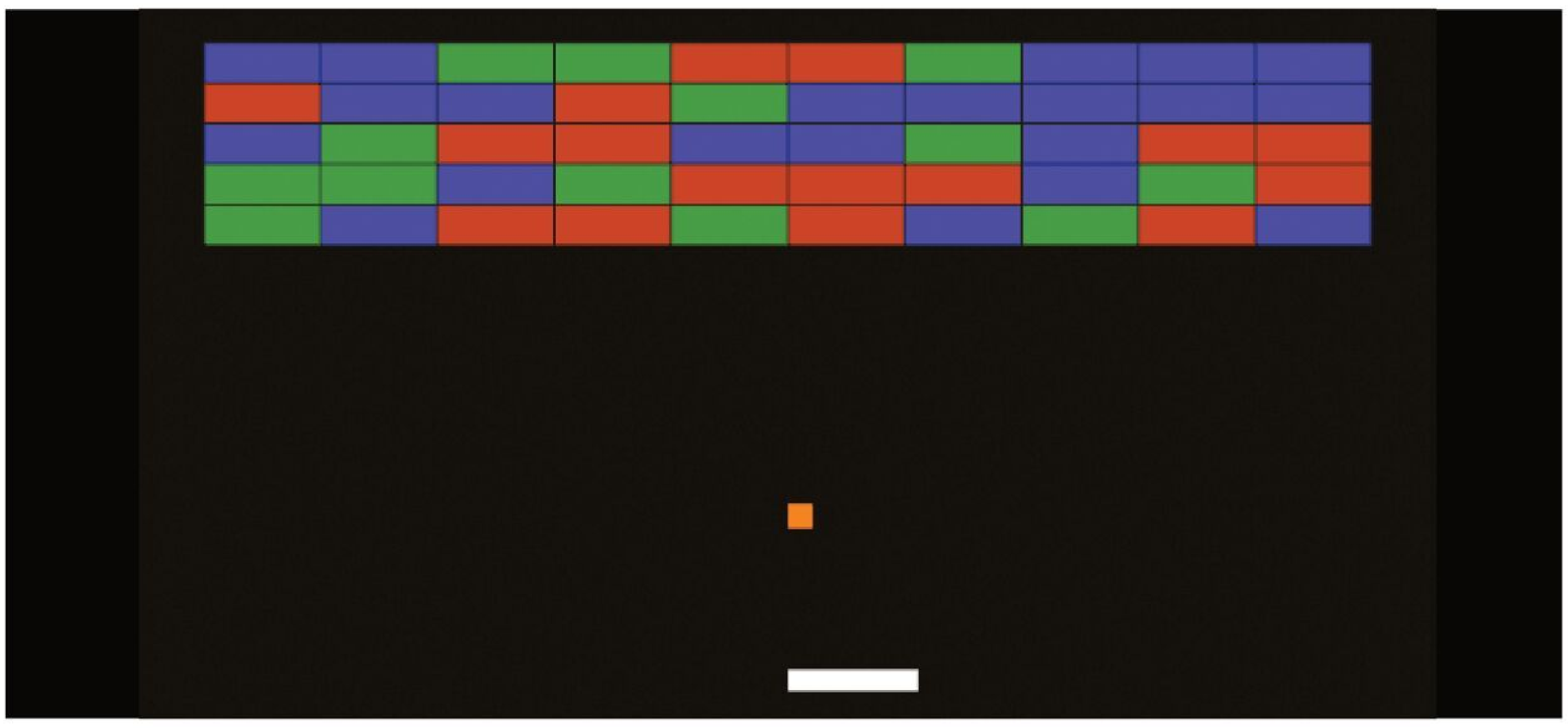
ludIssueTracker/ludIssueTracker/templates/ludissues/issue_detail.html

```
{% extends ‘base.html’ %}
{% block title %}Issue #{{ object.id }} - {% endblock %}
{% block content %}
<h2>Issue #{{ object.id }} <span>{{ object.status }}</span></h2>
<div class=”issue”>
        <h2>Information</h2>
<div class=”date”>
        <p class=”cr”>Opened {{ object.opened_on }} ago</p>
        <p class=”up”>Last modified {{ object.modified_on }} ago</p>
</div>
        <div class=”clear”>&nbsp;</div>
        <div class=”block w49 right”>
        <p class=”ass title”>Owner</p>
        <p class=”ass”>{{ object.owner }}</p>
        </div>
        <div class=”clear”>&nbsp;</div>
<div class=”block”>
        <p class=”des title”>Summary</p>
        <p class=”des”>{{ object.summary }}</p>
        </div>
</div>
{% endblock %}
```

And that’s everything! The issue tracker app is now complete and ready to use. You can now point your browser at localhost:8000 to start using the app.

Build an app for Android with Python

Master Kivy, the excellent cross-platform application framework to make your first Android app…



The great thing about Kivy is there are loads of directions we could take it in to do some pretty fancy things. But, we're going to make a beeline for one of Kivy's coolest features - the ability it affords you to easily run your programs on Android.

We'll approach this by first showing how to make a new app, this time a dynamic Breakout-style game. We'll then be able to compile this straight to an Android APK that you can use just like any other.

Of course, once you have mastered the basic techniques you aren't limited to using any particular kind of app, as even on Android you can make use of all your favourite Python libraries to make any sort of program you like.

Once you've mastered Kivy, your imagination is the only limit. If you're pretty new to Kivy, don't worry, we won't assume that you have any pre-existing knowledge. As long as you have mastered some of the Python in this book so far, and have a fairly good understanding of the language, you shouldn't have any problems following along with this.

Before anything else, let's throw together a basic Kivy app (Fig. 01). We've pre-imported the widget types we'll be using, which this time are just three: the basic Widget with no special behaviour, the ModalView with a pop-up behaviour as used last time, and the FloatLayout as we will explain later. Kivy has many other pre-built widgets for creating GUIs, but this time we're going to focus on drawing the whole GUI from scratch using Kivy's graphics instructions. These comprise either vertex instructions to create shapes (including rectangles, lines, meshes, and so on) or contextual graphics changes (such as translation, rotation, scaling, etc), and are able to be drawn anywhere on your screen and on any widget type.

Before we can do any of this we'll need a class for each kind of game object, which we're going to pre-populate with some of the properties that we'll need later to control them. Remember from last time, Kivy properties are special attributes declared at class level, which (among other things) can be modified via kv language and dispatch events when they are modified. The Game class will be one big widget containing the entire game. We've specifically made it a subclass of FloatLayout because this special layout is able to position and size its children in proportion to its own position and size – so no matter where we run it or how much we resize the window, it will place all the game objects appropriately.

Next we can use Kivy's graphics instructions to draw various shapes on our widgets. We'll just demonstrate simple rectangles to show their locations, though there are many more advanced options you might like to investigate. In a Python file we can apply any instruction by declaring it on the canvas of any widget, an example of which is shown in Fig. 03.

This would draw a red rectangle with the same position and size as the player at its moment of instantiation – but this presents a problem, unfortunately, because the drawing is static. When we later go on to move the player widget, the red rectangle will stay in the same place, while the widget will be invisible when it is in its real position.

We could fix this by keeping references to our canvas instructions and repeatedly updating their properties to track the player, but there's actually an easier way to do all of this - we can use the Kivy language we introduced last time. It has a special syntax for drawing on the widget canvas, which we can use here to draw each of our widget shapes:

```
<Player>:
  canvas:
    Color:
      rgba: 1, 1, 1, 1
    Rectangle:
      pos: self.pos
      size: self.size

<Ball>:
  canvas:
    Color:
      rgb: 1, 0.55, 0
    Rectangle:
      pos: self.pos
      size: self.size

<Block>:
  canvas:
    Color:
      rgb: self.colour
      # A property we
predefined above
    Rectangle:
      pos: self.pos
      size: self.size
    Color:
      rgb: 0.1, 0.1, 0.1
    Line:
      rectangle:
        [self.x, self.y,
        self.width, self.
height]
```

The canvas declaration is special, underneath it we can write any canvas instructions we like. Don't get confused, canvas is not a widget and nor are graphics instructions like Line. This is just a special syntax that is unique to the canvas. Instructions all have different properties that can be set, like the pos and size of the rectangle, and you can check the Kivy documentation online for all the different possibilities. The biggest advantage is that although we still declare simple canvas instructions, kv language is able to detect what Kivy properties we have referred to and automatically track them, so when they are updated (the widget moves or is resized) the canvas instructions move to follow this!

Fig 01

```
from kivy.app import App
from kivy.uix.widget import
Widget
from kivy.uix.floatlayout
import FloatLayout
from kivy.uix.modalview
import ModalView

__version__ = '0.1' #
Used later during Android
compilation

class BreakoutApp(App):
    pass

BreakoutApp().run()
```

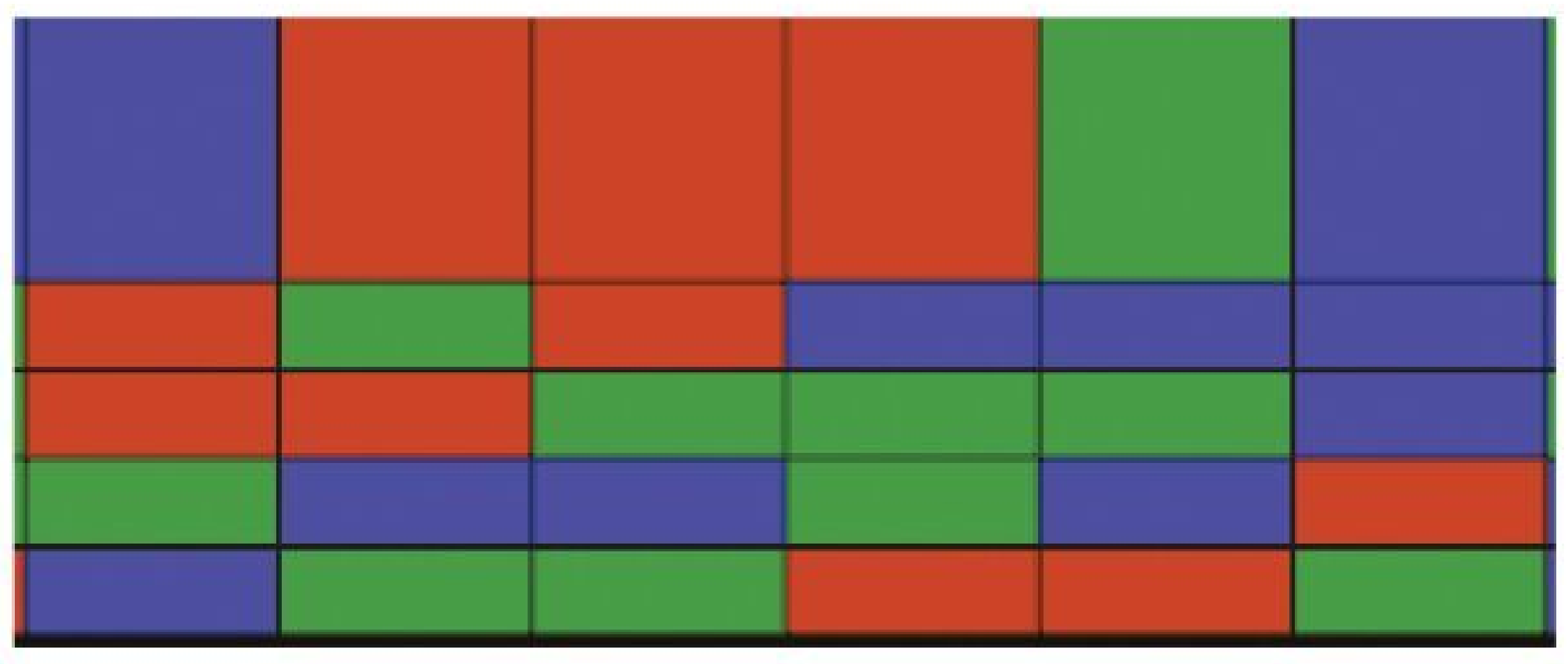
Fig 02

```
from kivy.properties
import (ListProperty,
NumericProperty,

ObjectProperty,
StringProperty)
```

```
    class Game(FloatLayout):
# Will contain everything
 blocks = ListProperty([])
  player = ObjectProperty()
# The game's Player instance
 ball = ObjectProperty() #
The game's Ball instance

  class Player(Widget): # A
moving paddle
 position =
NumericProperty(0.5)
 direction =
StringProperty('none')

    class Ball(Widget): # A
bouncing ball
         # pos_hints are for
proportional positioning,
see below
 pos_hint_x =
NumericProperty(0.5)
 pos_hint_y =
NumericProperty(0.3)
 proper_size =
NumericProperty(0.)
 velocity =
ListProperty([0.1, 0.5])

    class Block(Widget): #
Each coloured block to
destroy
                  colour =
ListProperty([1, 0, 0])
```

Fig 03

```
from kivy.graphics.context_
instructions import Color
        from kivy.graphics.
vertex_instructions import
Rectangle

    class Player(Widget):
            def __init__(self,
**kwargs):
                 super(Player,
self).__init__(**kwargs)
                   with self.
canvas:
                   Color(1, 0,
0, 1) # r, g, b, a -> red

Rectangle(pos=self.pos,
size=self.size)
                 # or without
the with syntax, self.
canvas.add(...)
```



Above Running the app shows our coloured blocks on the screen… but they all overlap! We can fix that easily

You probably noticed we had one of the Block's 'Color' instructions refer to its colour property. This means that we can change the property any time to update the colour of the block, or in this case to give each block a random colour (Fig. 04).

Now that each of our widgets has a graphical representation, let's now tell our Game where to place them, so that we can start up the app and actually see something there.

```
class Game(FloatLayout):
  def setup_blocks(self):
    for y_jump in range(5):
      for x_jump in
range(10):
        block = Block(pos_
hint={
            'x': 0.05 + 0.09*x_
jump,
            'y': 0.05 + 0.09*y_
jump})
        self.blocks.
append(block)
        self.add_
widget(block)
class BreakoutApp(App):
  def build(self):
    g = Game()
    g.setup_blocks()
    return g
```

Here we create the widgets we want then use add_widget to add them to the graphics tree. Our root widget on the screen is an instance of Game and every block is added to that to be displayed.

The only new thing in there is that every Block has been given a pos_hint. All widgets have this special property, and it is used by FloatLayouts like our Game to set their position proportionately to the layout.

The dictionary is able to handle various parameters, but in this case 'x'and 'y' give x and y Block position as a relative fraction of the parent width and height.

You can run the app now, and this time it will add 50 blocks to the Game before displaying it on the screen. Each should have one of the three possible random colours and be positioned in a grid, but you'll now notice their sizes haven't been manually set so they all overlap. We can fix this by setting their size_hint properties – and let's also take this opportunity to do the same for the other widgets as well (Fig. 05).

This takes care of keeping all our game widgets positioned and sized in proportion to the Game containing them. Notice that the Player and Ball use references to the properties we set earlier, so we'll be able to move them by just setting these properties and letting kv language automatically update their positions.

The Ball also uses an extra property to remain square rather than rectangular, just because the alternative would likely look a little bit odd.

We've now almost finished the basic graphics of our app! All that remains is to add a Ball and a Player widget to the Game.

```
<Game>:
  ball: the_ball
  player: the_player
  Ball:
    id: the_ball
  Player:
    id: the_player
```

You can run the game again now, and should be able to see all the graphics working properly. Nothing moves yet, but thanks to the FloatLayout everything should remain in proportion if you resize the game/window.

Now we just have to add the game mechanics. For a game like this you usually want to run some update function many times per second, updating the widget positions and carrying out game logic – in this case collisions with the ball (Fig. 06).

The Clock can schedule any function at any time, either once or repeatedly. A function scheduled at interval automatically receives the time since its last call (dt here), which we've passed through to the ball and player via the references we created in kv language. It's good practice to scale the update (eg ball distance moved) by this dt, so things remain stable even if something interrupts the clock and updates don't meet the regular 1/60s you want.

At this point we have also added the first steps toward handling keyboard input, by binding to the kivy Window to call a method of the Player every time a key is pressed. We can then finish off the Player class by adding this key handler along with touch/mouse input.

```
class Player(Widget):
  def on_touch_down(self,
touch):
      self.direction = (
        'right' if touch.x >
self.parent. ↵center_x else
'left')

  def on_touch_up(self,
touch):
      self.direction = 'none'

  def on_key_down(self,
keypress, ↵scancode, *args):
    if scancode == 275:
      self.direction =
'right'
    elif scancode == 276:
      self.direction = 'left'
    else:
      self.direction = 'none'

  def on_key_up(self, *args):
    self.direction = 'none'

  def update(self, dt):
    dir_dict = {'right': 1,
'left': -1, 'none': 0}
      self.position += (0.5
* dt * dir_ ↵dict[self.
direction])
```

These on_touch_ functions are Kivy's general method for interacting with touch or mouse input, they are automatically called when the input is detected and you can do anything you like in response to the touches you receive. In this case we set the Player's direction property in response to either keyboard and touch/mouse input, and use this direction to move the Player when its update method is called. We can also add the right behaviour for the ball (Fig. 07).

This makes the ball bounce off every wall by forcing its velocity to point back into the Game, as well as bouncing from the player paddle – but with an extra kick just to let the ball speed change. It doesn't yet handle any interaction with the blocks or any win/lose conditions, but it does try to call Game.lose() if the ball hits the bottom of the player's screen, so let's now add in some game end code to handle all of this (Fig. 08). And then add the code in Fig. 09 to your 'breakout.kv 'file.

This should fully handle the loss or win, opening a pop-up with an appropriate message and providing a button to try again. Finally, we have to handle destroying blocks when the ball hits them (Fig. 10).

This fully covers these last conditions, checking collision via Kivy's built-in collide_widget method that compares their bounding boxes (pos and size). The bounce direction will depend on how far the ball has penetrated, as this will tell us how it first collided with the Block.

So there we have it, you can run the code to play your simple Breakout game. Obviously it's very simple right now, but hopefully you can see lots of different ways to add whatever extra behaviour you like – you could add different types of blocks and power-ups, a lives system, more sophisticated paddle/ball interaction, or even build a full game interface with a menu and settings screen as well.

We're just going to finish showing one cool thing that you can already do – compile your game for Android! Generally speaking you can take any Kivy app and turn it straight into an Android APK that will run on any of your Android devices. You can even access the normal Android API to access hardware or OS features such as vibration, sensors or native notifications.

We'll build for Android using the Buildozer tool, and a Kivy sister project wrapping other build tools to create packages on different systems. This takes care of downloading and running the Android build tools (SDK, NDK, etc) and Kivy's Python-for-Android tools that create the APK.

Fig 04

```
import random

    class Block(Widget):
          def __init__(self,
**kwargs):
                super(Block,
self).__init__(**kwargs)
               self.colour =
random.choice([
                 (0.78, 0.28,
0), )0.28, 0.63, 0.28), )0.25,
0.28, 0.78)])
```

Fig 05

```
<Block>:
    size_hint: 0.09, 0.05
    # ... canvas part

<Player>:
    size_hint: 0.1, 0.025
        pos_hint: {'x': self.
position, 'y': 0.1}
    # ... canvas part

<Ball>:
      pos_hint: {'x': self.pos_
hint_x, 'y': self.pos_hint_y}
    size_hint: None, None
    proper_size:
          min(0.03*self.parent.
height, 0.03*self.parent.width)
        size: self.proper_size,
self.proper_size
    # ... canvas part
```

Fig 06

```
      from kivy.clock import
Clock
        from kivy.core.window
import Window
      from kivy.utils import
platform

    class Game(FloatLayout):
        def update(self, dt):
                    self.ball.
update(dt)  # Not defined yet
                  self.player.
update(dt)  # Not defined yet

              def start(self,
*args):
               Clock.schedule_
interval(self.update, 1./60.)

        def stop(self):
                        Clock.
unschedule(self.update)

        def reset(self):
              for block in
self.blocks:
                 self.remove_
widget(block)
            self.blocks = []
                 self.setup_
blocks()
            self.ball.velocity
= [random.random(), 0.5]
                  self.player.
position = 0.5

    class BreakoutApp(App):
        def build(self):
```

```
        g = Game()
        if platform() != 'android':
            Window.bind(on_key_down=g.player.on_key_down)
            Window.bind(on_key_up=g.player.on_key_up)
        g.reset()
        Clock.schedule_once(g.start, 0)
        return g
```

Fig 07

```
class Ball(Widget)
    def update(self, dt):
        self.pos_hint_x += self.velocity[0] * dt
        self.pos_hint_y += self.velocity[1] * dt
        if self.right > self.parent.right:  # Bounce from right
            self.velocity[0] = -1 * abs(self.velocity[0])
        if self.x < self.parent.x:  # Bounce from left
            self.velocity[0] = abs(self.velocity[0])
        if self.top > self.parent.top:  # Bounce from top
            self.velocity[1] = -1 * abs(self.velocity[1])
        if self.y < self.parent.y:  # Lose at bottom
            self.parent.lose()  # Not implemented yet
        self.bounce_from_player(self.parent.player)

    def bounce_from_player(self, player):
        if self.collide_widget(player):
            self.velocity[1] = abs(self.velocity[1])
            self.velocity[0] += (
                0.1 * ((self.center_x - player.center_x) / player.width))
```

Fig 08

```
class GameEndPopup(ModalView):
    message = StringProperty()
    game = ObjectProperty()

class Game(Widget):
    def lose(self):
        self.stop()
        GameEndPopup(message='[color=#ff0000]You lose![/color]',
                     game=self).open()

    def win(self):  # Not called yet, but we'll need it later
        self.stop()
        GameEndPopup(message='[color=#00ff00]You win![/color]',
                     game=self).open()
```

Fig 09

```
<GameEndPopup>:
    size_hint: 0.8, 0.8
    auto_dismiss: False  # Don't close if player clicks outside
    BoxLayout:
        orientation: 'vertical'
        Label:
            text: root.message
            font_size: 60
            markup: True
            halign: 'center'
        Button:
            size_hint_y: None
            height: sp(80)
            text: 'Play again?'
            font_size: 60
            on_release: root.game.start(); root.dismiss()
```

Here you will be needing some basic dependencies, which can be installed with ease just by using your distro's normal repositories. The main ones to use are OpenJDK7, zlib, an up-to-date Cython, and Git. If you are using a 64-bit distro you will also be in need of 32-bit compatibility libraries for zlib, libstdc++, as well as libgcc. You can then go on and download and install Buildozer:

Putting your APK on the Play Store

Find out how to digitally sign a release APK and upload it to an app store of your choice

1 Build and sign a release APK

Begin by creating a personal digital key, then using it to sign a special release version of the APK. Run these commands, and follow the instructions.

```
## Create your personal
digital key          ##
You can choose your own
## keystore name, alias,
and passwords.
$ keytool -genkey -v
-keystore test- ↵release-
key.keystore \
   -alias test-alias
-keyalg RSA ↵

-keysize 2048 -validity
10000
## Compile your app in
release mode
$ buildozer android
release ↵
## Sign the APK with your
new key
$ jarsigner -verbose
-sigalg ↵
SHA1withRSA -digestalg
SHA1 \
   -keystore ./test-
release-key.keystore \
   ./bin/KivyBreakout-0.1-
release- ↵
unsigned.apk test-alias
## Align the APK zip file
$ ~/.buildozer/android/
platform/android- ↵sdk-21/
tools/zipalign -v 4 \
   ./bin/KivyBreakout-0.1-
release- ↵
unsigned.apk \
   ./bin/KivyBreakout-0.1-
release.apk
```

> "Check through the whole file just to see what's available, but most of the default settings will be fine"

```
git clone git://github.com/
kivy/buildozer
cd buildozer
sudo python2.7 setup.py
install
```

When you're done with that part you can then go on and navigate to your Kivy app, and you'll have to name the main code file 'main.py', this is the access point that the Android APK will expect. Then:

```
buildozer init
```

This creates a 'buildozer.spec' file, a settings file containing all the information that Buildozer needs to create your APK, from the name and version to the specific Android build options. We suggest that you check through the whole file just to see what's available but most of the default settings will be fine, the only thing we suggest changing is (Fig. 11).

There are various other options you will often want to set, but none are really all that vital right now, so you're able to immediately tell Buildozer to build your APK and get going!

```
buildozer android debug
```

This will take some time, so be patient and it will work out fine. When you first run it, it will download both the Android SDK and NDK, which are large (at least hundreds of megabytes) but vital to the build. It will also take time to build these and to compile the Python components of your APK. A lot of this only needs to be done once, as future builds will take a couple of minutes if you change the buildozer.spec, or just a few seconds if you've only changed your code.

The APK produced is a debug APK, and you can install and use it. There are extra steps if you want to digitally sign it so that it can be posted on the Play store. This isn't hard, and Buildozer can do some of the work, but check the documentation online for full details.

Assuming everything goes fine (it should!), your Android APK will be in a newly created 'bin' directory with the name 'KivyBreakout-0.1-debug.apk'. You can send it to your phone any way you like (eg email), though you may need to enable application installation from unknown sources in your Settings before you can install it.

Fig 10

```
                self.parent.do_
layout()
           self.parent.destroy_
blocks(self)

class Game(FloatLayout):
     def destroy_blocks(self,
ball):
              for i, block in
enumerate(self.blocks):
                      if ball.
collide_widget(block):
                      y_overlap
= (
                          ball.
top - block.y if ball.
velocity[1] > 0
                           else
block.top - ball.y) / block.
size_hint_y
                      x_overlap
= (
                          ball.
right - block.x if ball.
velocity[0] > 0
                           else
block.right - ball.x) /
block.size_hint_x
                     if x_
overlap < y_overlap:

ball.velocity[0]     *=
-1

else:

ball.velocity[1]     *=
-1

                     self.
remove_widget(block)
                    self.blocks.
pop(i)
                if len(self.
blocks) == 0:
                          self.
win()
                  return   #
Only remove at most 1 block
per frame
```

Fig 11

```
title = Kivy Breakout    #
Displayed in your app drawer
package.name = breakout   #
Just a unique identifying
string,
                              #
along with the package.
domain
fullscreen = 0  # This will
mean the navbar is not
covered
log_level = 2  # Not vital,
but this will print a lot
more debug
                # information
and may be useful if
something
               # goes wrong
```

2 Sign up as a Google Play Developer

Visit https://play.google.com/apps/publish/signup, and follow the instructions. You'll need to pay a one-off $25 charge, but then you can upload as many apps as you like.

3 Upload your app to the store

Click 'Add new application' to submit your app the store, including uploading your APK and adding description text. When everything is ready, simply click Publish, and it should take just a few hours for your app to go live!

SAMSUNG
22:44

Above Your game should run on any modern Android device… you can even build a release version and publish to an app store!

50 Python tips

Python is a programming language that lets you work more quickly and integrate your systems more effectively. Today, Python is one of the most popular programming languages in the open source space. Look around and you will find it running everywhere, from various configuration tools to XML parsing. Here is the collection of 50 gems to make your Python experience worthwhile…

Basics

Running Python scripts

01 On most of the UNIX systems, you can run Python scripts from the command line.

```
$ python mypyprog.py
```

Running Python programs from Python interpreter

02 The Python interactive interpreter makes it easy to try your first steps in programming and using all Python commands. You just issue each command at the command prompt (>>>), one by one, and the answer is immediate.

Python interpreter can be started with the command:

```
$ python
kunal@ubuntu:~$ python
Python 2.6.2 (release26-maint, Apr 19 2009, 01:56:41)
[GCC 4.3.3] on linux2
Type “help”, “copyright”, “credits” or “license” for more information.
>>> <type commands here>
```

In this article, all the code starting at the >>> symbol is to be given at the Python prompt.

It is also important to remember that Python takes tabs very seriously – so if you are receiving any error that mentions tabs, correct the tab spacing.

Dynamic typing

03 In Java, C++, and other statically typed languages, you must specify the data type of the function return value and each function argument. On the other hand, Python is a dynamically typed language. In Python you will never have to explicitly specify the data type of anything you use. Based on what value you assign, Python will automatically keep track of the data type internally.

Python statements

04 Python uses carriage returns to separate statements, and a colon and indentation to separate code blocks. Most of the compiled programming languages, such as C and C++, use semicolons to separate statements and curly brackets to separate code blocks.

== and = operators

05 Python uses '==' for comparison and '=' for assignment. Python does not support inline assignment, so there's no chance of accidentally assigning the value when you actually want to compare it.

Concatenating strings

06 You can use '+' to concatenate strings.

```
>>> print ‘kun’+’al’
kunal
```

The __init__ method

07 The __init__ method is run as soon as an object of a class is instantiated. The method is useful to do any initialization you want to do with your object. The __init__ method is analogous to a constructor in C++, C# or Java.

Example:

```
class Person:
  def __init__(self, name):
    self.name = name
  def sayHi(self):
        print ‘Hello, my name is’, self.name
p = Person(‘Kunal’)
p.sayHi()
```

Output:

```
[~/src/python $:] python initmethod.py
Hello, my name is Kunal
```

Modules

08 To keep your programs manageable as they grow in size you may want to make them into several files. Python allows you to put multiple function definitions into a file and use them as a module that can be imported. These files must have a .py extension however.

Example:

```
# file my_function.py
def minmax(a,b):
if a <= b:
min, max = a, b
else:
min, max = b, a
return min, max
Module Usage
import my_function
```

Module defined names

09 **Example:**
The built-in function ‘dir()’ can be used to find out which names a module defines. It returns a sorted list of strings.

```
>>> import time
>>> dir(time)
      [‘__doc__’, ‘__file__’,
      ‘__name__’, ‘__package__’,
‘accept2dyear’, ‘altzone’,
‘asctime’, ‘clock’, ‘ctime’,
‘daylight’, ‘gmtime’, ‘localtime’,
‘mktime’, ‘sleep’, ‘strftime’,
‘strptime’, ‘struct_time’,
‘time’, ‘timezone’, ‘tzname’,
‘tzset’]file’]
```

Module internal documentation

10 You can see the internal documentation (if available) of a module name by looking at .__doc__.

Example:

```
>>> import time
>>> print time.clock.__doc__
clock() -> floating
point number
```

This example returns the CPU time or real time since the start of the process or since the first call to clock(). This has just as much precision as the system records do.

Passing arguments to a Python script

11 Python lets you access whatever you have passed to a script while calling it. The ‘command line’ content is stored in the sys.argv list.

```
import sys
print sys.argv
```

Loading modules or commands at startup

12 You can load predefined modules or commands at the startup of any Python script by using the environment variable $PYTHONSTARTUP. You can set environment variable $PYTHONSTARTUP to a file which contains the instructions load necessary modules or commands .

Converting a string to date object

13 You can use the function ‘DateTime’ to convert a string to a date object.

Example:

```
from DateTime import DateTime
dateobj = DateTime(string)
```

Converting a string to date object

14 You can convert a list to string in the following ways.

1st method:

```
>>> mylist = [‘spam’, ‘ham’,
‘eggs’]
>>> print ‘, ‘.join(mylist)
spam, ham, eggs
```

2nd method:

```
>>> print ‘\n’.join(mylist)
spam
ham
eggs
```

Tab completion in Python interpreter

15 You can achieve auto completion inside Python interpreter by adding these lines to your .pythonrc file (or your file for Python to read on startup):

```
import rlcompleter, readline
readline.parse_and_bind(‘tab:
complete’)
```

This will make Python complete partially typed function, method and variable names when you press the Tab key.

Python documentation tool

16 You can pop up a graphical interface for searching the Python documentation using the command:

```
$ pydoc -g
```

You will need python-tk package for this to work.

> “Today, Python is certainly one of the most popular programming languages to be found in the open source space”

Accessing the Python documentation server

17 You can start an HTTP server on the given port on the local machine. This will give you a nice-looking access to all Python documentation, including third-party module documentation.

```
$ pydoc -p <portNumber>
```

Python development software

18 There are plenty of tools to help with Python development. Here are a few important ones:

IDLE: The Python built-in IDE, with autocompletion, function signature popup help, and file editing.

IPython: Another enhanced Python shell with tab-completion and other features.

Eric3: A GUI Python IDE with autocompletion, class browser, built-in shell and debugger.

WingIDE: Commercial Python IDE with free licence available to open-source developers everywhere.

Built-in modules

Executing at Python interpreter termination

19 You can use ‘atexit’ module to execute functions at the time of Python interpreter termination.

Example:

```
def sum():
       print(4+5)
def message():
       print(“Executing  Now”)
import atexit
atexit.register(sum)
atexit.register(message)
```

Output:

```
Executing Now
9
```

Converting from integer to binary and more

20 Python provides easy-to-use functions – bin(), hex() and oct() – to convert from integer to binary, decimal and octal format respectively.

Example:

```
>>> bin(24)
‘0b11000’
>>> hex(24)
‘0x18’
>>> oct(24)
‘030’
```

Converting any charset to UTF-8

21 You can use the following function to convert any charset to UTF-8.

```
data.decode(“input_charset_
here”).encode(‘utf-8’)
```

Removing duplicates from lists

22 If you want to remove duplicates from a list, just put every element into a dict as a key (for example with ‘none’ as value) and then check dict.keys().

```
from operator import setitem
def distinct(l):
   d = {}
   map(setitem, (d,)*len(l),
l, [])
   return d.keys()
```

Do-while loops

23 Since Python has no do-while or do-until loop constructs (yet), you can use the following method to achieve similar results:

```
while True:
   do_something()
   if condition():
       break
```

Detecting system platform

24 To execute platform-specific functions, it is very useful to be able to detect the platform on which the Python interpreter is running. You can use ‘sys.platform’ to find out the current platform.

Example:

On Ubuntu Linux

```
>>> import sys
>>> sys.platform
‘linux2’
```

On Mac OS X Snow Leopard

```
>>> import sys
>>> sys.platform
‘darwin’
```

Disabling and enabling garbage collection

25 Sometimes you may want to enable or disable the garbage collector function at runtime. You can use the ‘gc’ module to enable or disable the garbage collection.

Example:

```
>>> import gc
>>> gc.enable
<built-in function enable>
>>> gc.disable
<built-in function
disable>
```

Using C-based modules for better performance

26 Many Python modules ship with counterpart C modules. Using these C modules will give a significant performance boost in your complex applications.

Example:

```
cPickle instead of
Pickle, cStringIO instead
of StringIO .
```

Calculating maximum, minimum and sum

27 You can use the following built-in functions.

max: Returns the largest element in the list.

min: Returns the smallest element in the list.

sum: This function returns the sum of all elements in the list. It accepts an optional second argument: the value to start with when summing (defaults to 0).

Representing fractional numbers

28 Fraction instance can be created in Python using the following constructor:

```
Fraction([numerator [,denominator]])
```

Performing math operations

29 The 'math' module provides a plethora of mathematical functions. These functions work on integer and float numbers, except complex numbers. For complex numbers, a separate module is used, called 'cmath'.

For example:

```
math.acos(x): Return arc cosine of x.
math.cos(x): Returns cosine of x.
math.factorial(x) : Returns x factorial.
```

Working with arrays

30 The 'array' module provides an efficient way to use arrays in your programs. The 'array' module defines the following type:

```
array(typecode [, initializer])
```

Once you have created an array object, say myarray, you can apply a bunch of methods to it. Here are a few important ones:

```
myarray.count(x): Returns the number of occurrences of x in a.
myarray.extend(x): Appends x at the end of the array.
myarray.reverse(): Reverse the order of the array.
```

Sorting items

31 The 'bisect' module makes it very easy to keep lists in any possible order. You can use the following functions to order lists.

```
bisect.insort(list, item [, low [, high]])
```

Inserts item into list in sorted order. If item is already in the list, the new entry is inserted to the right of any existing entries there.

```
bisect.insort_left(list, item [, low [, high]])
```

Inserts item into list in sorted order. If item is already within the list, the new entry is inserted to the left of any existing entries.

Using regular expression-based search

32 The 're' module makes it very easy to use regxp-based searches. You can use the function 're.search()' with a regexp-based expression. Check out the example included below.

Example:

```
>>> import re
>>> s = “Kunal is a bad boy”
>>> if re.search(“K”, s): print “Match!” # char literal
...
Match!
>>> if re.search(“[@A-Z]”, s): print “Match!”  # char class
... # match either at-sign or capital letter
Match!
>>> if re.search(“\d”, s): print “Match!” # digits class
...
```

Working with bzip2 (.bz2) compression format

33 You can use the module 'bz2' to read and write data using the bzip2 compression algorithm.

```
bz2.compress() :  For bz2 compression
bz2.decompress() : For bz2 decompression
```

Example:

```
# File: bz2-example.py
import bz2
MESSAGE = “Kunal is a bad boy”
compressed_message = bz2.compress(MESSAGE)
decompressed_message = bz2.decompress(compressed_message)
print “original:”, repr(MESSAGE)
print “compressed message:”, repr(compressed_ message)
print “decompressed message:”, repr(decompressed_message)
```

Output:

```
[~/src/python $:] python bz2-example.py
original: ‘Kunal is a bad boy’
compressed message: ‘BZh91AY&SY\xc4\x0fG\x98\ x00\x00\x02\x15\x80@\x00\x00\x084%\x8a  \x00”\x00\x0c\x84\r\x03C\xa2\xb0\xd6s\xa5\xb3\x19\x00\xf8\xbb\x92)\xc2\x84\x86 z<\xc0’
decompressed message: ‘Kunal is a bad boy’
```

> “There are tools to help develop with Python”

Using SQLite database with Python

34 SQLite is fast becoming a very popular embedded database because of the zero configuration that is needed, and its superior levels of performance. You can use the module 'sqlite3' in order to work with these SQLite databases.

Example:

```
>>> import sqlite3
>>> connection = sqlite.
connect('test.db')
>>> curs = connection.
cursor()
>>> curs.execute('''create
table item
... (id integer primary key,
itemno text unique,
... scancode text, descr text,
price real)''')
<sqlite3.Cursor object at
0x1004a2b30>
```

Working with zip files

35 You can use the module 'zipfile' to work with zip files.

```
zipfile.ZipFile(filename
[, mode [, compression
[,allowZip64]]])
```

Open a zip file, where the file can be either a path to a file (a string) or a file-like object.

```
zipfile.close()¶
```

Close the archive file. You must call 'close()' before exiting your program or essential records will not be written.

```
zipfile.extract(member[,
path[, pwd]])
```

Extract a member from the archive to the current working directory; 'member' must be its full name (or a zipinfo object). Its file information is extracted as accurately as possible. 'path' specifies a different directory to extract to. 'member' can be a filename or a zipinfo object. 'pwd' is the password used for encrypted files.

Using wildcards to search for filenames

36 You can use the module 'glob' to find all the pathnames matching a pattern according to the rules used by the UNIX shell. *, ?, and character ranges expressed with [ ] will be matched.

Example:

```
>>> import glob
>>> glob.glob('./[0-9].*')
['./1.gif', './2.txt']
>>> glob.glob('*.gif')
['1.gif', 'card.gif']
>>> glob.glob('?.gif')
['1.gif']
```

Performing basic file operations

37 You can use the module 'shutil' to perform basic file operation at a high level. This module works with your regular files and so will not work with special files like named pipes, block devices, and so on.

```
shutil.copy(src,dst)
```

Copies the file src to the file or directory dst.

```
shutil.copymode(src,dst)
```

Copies the file permissions from src to dst.

```
shutil.move(src,dst)
```

Moves a file or directory to dst.

```
shutil.copytree(src, dst,
symlinks [,ignore]])
```

Recursively copy an entire directory at src.

```
shutil.rmtree(path [, ignore_
errors [,  onerror]])
```

Deletes an entire directory.

Executing UNIX commands from Python

38 You can use module commands to execute UNIX commands. This is not available in Python 3 – instead, in this, you will need to use the module 'subprocess'.

Example:

```
>>> import commands
>>> commands.
getoutput('ls')
'bz2-example.py\ntest.py'
```

Reading environment variables

39 You can use the module 'os' to gather up some operating-system-specific information:

Example:

```
>>> import os
>>> os.path <module 'posixpath'
from '/usr/lib/python2.6/
posixpath.pyc'>>>>  os.environ
{'LANG': 'en_IN', 'TERM': 'xterm-
color', 'SHELL':
'/bin/bash', 'LESSCLOSE':
'/usr/bin/lesspipe %s %s',
'XDG_SESSION_COOKIE':
'925c4644597c791c704656354adf56d6-
1257673132.347986-1177792325',
'SHLVL': '1', 'SSH_TTY': '/dev/
pts/2', 'PWD': '/ home/kunal',
'LESSOPEN': '| /usr/bin
lesspipe
......}
>>> os.name
'posix'
>>> os.linesep
'\n'
```

> "Look around and you will find Python everywhere, from various configuration tools to XML parsing"

Sending email

40 You can use the module 'smtplib' to send email using an SMTP (Simple Mail Transfer Protocol) client interface.

```
smtplib.SMTP([host [, port]])
```

Example (send an email using Google Mail SMTP server):

```
import smtplib
# Use your own to and from
email address
fromaddr = 'kunaldeo@gmail.com'
toaddrs  = 'toemail@gmail.com'
msg = 'I am a Python geek.
Here is the  proof.!'
# Credentials
# Use your own Google Mail
credentials  while running the
program
username = 'kunaldeo@gmail.com'
password = 'xxxxxxxx'
# The actual mail send
server = smtplib.SMTP('smtp.
gmail.com:587')
# Google Mail uses secure
connection for  SMTP connections
server.starttls()
server.login(username,password)
server.sendmail(fromaddr,
toaddrs, msg)
server.quit()
```

Accessing FTP server

41 'ftplib' is a fully fledged client FTP module for Python. To establish an FTP connection, you can use the following function:

```
smtplib.SMTP([host [, port]])
```

Example (send an email using Google Mail SMTP server):

```
ftplib.FTP([host [, user [,
passwd [, acct  [, timeout]]]]])
```

Example:

```
host = "ftp.redhat.com"
username = "anonymous"
password = "kunaldeo@gmail.
com"
import ftplib
import urllib2
ftp_serv = ftplib.
FTP(host,username,password)
# Download the file
u = urllib2.urlopen ("ftp://
ftp.redhat.com/ pub/redhat/
linux/README")
# Print the file contents
print (u.read())
```

Output:

```
[~/src/python $:] python
ftpclient.py
```

Older versions of Red Hat Linux have been moved to the following location: ftp://archive.download.redhat.com/pub/redhat/linux/

Launching a webpage with the web browser

42 'The 'webbrowser' module provides a convenient way to launch webpages using the default web browser.

Example (launch google.co.uk with system's default web browser):

```
>>> import webbrowser
>>> webbrowser.open('http://
google.co.uk')
True
```

Creating secure hashes

43 The 'hashlib' module supports a plethora of secure hash algorithms including SHA1, SHA224, SHA256, SHA384, SHA512 and MD5.

Example (create hex digest of the given text):

```
>>> import hashlib
# sha1 Digest
>>> hashlib.sha1("MI6
Classified Information  007").
hexdigest()
'e224b1543f229cc0cb935a1eb9593
18ba1b20c85'
# sha224 Digest
>>> hashlib.sha224("MI6
Classified
Information 007").hexdigest()

'3d01e2f741000b0224084482f905e9b7b97
7a59b480990ea8355e2c0'
# sha256 Digest
>>> hashlib.sha256("MI6 Classified
Information 007").hexdigest()
'2fdde5733f5d47b672fcb39725991c89
b2550707cbf4c6403e fdb33b1c19825e'
# sha384 Digest
>>> hashlib.sha384("MI6 Classified
Information 007").hexdigest()
'5c4914160f03dfbd19e14d3ec1e74bd8b99
dc192edc138aaf7682800982488daaf540be
9e0e50fc3d3a65c8b6353572d'
# sha512 Digest
>>> hashlib.sha512("MI6 Classified
Information 007").hexdigest()
'a704ac3dbef6e8234578482a31d5ad29d25

2c822d1f4973f49b850222edcc0a29bb89077

8aea807a0a48ee4ff8bb18566140667fbaf7
3a1dc1ff192febc713d2'
# MD5 Digest
>>> hashlib.md5("MI6 Classified
Information 007").hexdigest()
'8e2f1c52ac146f1a999a670c826f7126'
```

Seeding random numbers

44 You can use the module 'random' to generate a wide variety of random numbers. The most used one is 'random.seed([x])'. It initialises the basic random number generator. If x is omitted or None, the current system time is used; the current system time is also used to initialise the generator when the module is first imported.

> "Programming in Python lets you work more quickly and integrate your systems much more effectively"

Working with CSV files

45 CSV files are very popular for data exchange over the web. Using the module 'csv', you can read and write CSV files.

Example:

```
import csv
# write stocks data as comma- separated values
writer = csv.writer(open(‘stocks.csv’, ‘wb’, buffering=0))
writer.writerows([
 (‘GOOG’, ‘Google, Inc.’, 505.24,  0.47, 0.09),
 (‘YHOO’, ‘Yahoo! Inc.’, 27.38,  0.33, 1.22),
 (‘CNET’, ‘CNET Networks, Inc.’,  8.62, -0.13, -1.49)
 ])
# read stocks data, print status messages
stocks = csv.reader(open(‘stocks.csv’, ‘rb’))
status_labels = {-1: ‘down’, 0: ‘unchanged’, 1: ‘up’}
for ticker, name, price, change, pct in stocks:
    status = status_labels[cmp(float(change), 0.0)]
    print ‘%s is %s (%s%%)’ %  (name, status, pct)
```

Installing third-party modules using setuptools

46 'setuptools' is a Python package which lets you download, build, install, upgrade and uninstall packages very easily. To use the 'setuptools' package you will need to install these from your distribution's package manager.

After installation you can use the command 'easy_install' to perform any Python package management tasks that are necessary at that point.

Example (installing simplejson using setuptools):

```
kunal@ubuntu:~$ sudo easy_ install simplejson
Searching for simplejson
Reading http://pypi.python.org/simple/simplejson/
Reading http://undefined.org/python/#simplejson
Best match: simplejson 2.0.9
Downloading http://pypi.python.org/packages/source/s/simplejson/simplejson-2.0.9.tar.gz#md5=af5e67a39ca3408563411d357e6d5e47
Processing simplejson-2.0.9.tar.gz
Running simplejson-2.0.9/setup.py -q bdist_egg --dist-dir /tmp/easy_install-FiyfNL/simplejson-2.0.9/egg-dist-tmp-3YwsGV
Adding simplejson 2.0.9 to easy-install.pth file
Installed /usr/local/lib/python2.6/dist-packages/simplejson-2.0.9-py2.6-linux-i686.egg
Processing dependencies for simplejson
Finished processing dependencies for simplejson
```

> "You can use the module 'random' to generate a wide variety of random numbers with the basic generator"

Logging to system log

47 You can use the module 'syslog' to write to system log. 'syslog' acts as an interface to UNIX syslog library routines.

Example:

```
import syslog
syslog.syslog(‘mygeekapp: started logging’)
for a in [‘a’, ‘b’, ‘c’]:
  b = ‘mygeekapp: I found letter ‘+a
  syslog.syslog(b)
syslog.syslog(‘mygeekapp: the script goes to sleep now, bye,bye!’)
```

Output:

```
$ python mylog.py
$ tail -f /var/log/messages
Nov  8 17:14:34 ubuntu -- MARK --
Nov  8 17:22:34 ubuntu python: mygeekapp: started logging
Nov  8 17:22:34 ubuntu python: mygeekapp: I found letter a
Nov  8 17:22:34 ubuntu python: mygeekapp: I found letter b
Nov  8 17:22:34 ubuntu python: mygeekapp: I found letter c
Nov  8 17:22:34 ubuntu python: mygeekapp: the script goes  to sleep now, bye,bye!
```

Third-party modules

Generating PDF documents

48 'ReportLab' is a very popular module for PDF generation from Python.

Perform the following steps to install ReportLab

```
$ wget http://www.reportlab.org/ftp/
```

```
ReportLab_2_3.tar.gz
$ tar xvfz ReportLab_2_3.tar.gz
$ cd ReportLab_2_3
$ sudo python setup.py install
```

For a successful installation, you should see a similar message:

```
############SUMMARY INFO###########
####################################
#Attempting install of _rl_accel, sgmlop &  pyHnj
#extensions from ‘/home/kunal/python/ ReportLab_2_3/src/rl_addons/rl_accel’
####################################
#Attempting install of _renderPM
#extensions from ‘/home/kunal/python/ ReportLab_2_3/src/rl_addons/renderPM’
# installing with freetype version 21
####################################
```

Example:

```
>>> from reportlab.pdfgen.canvas import Canvas
# Select the canvas of letter page size
>>> from reportlab.lib.pagesizes import letter
>>> pdf = Canvas(“bond.pdf”, pagesize = letter)
# import units
>>> from reportlab.lib.units import cm, mm,  inch, pica
>>> pdf.setFont(“Courier”, 60)
>>> pdf.setFillColorRGB(1, 0, 0)
>>> pdf.drawCentredString(letter[0] / 2, inch *  6, “MI6 CLASSIFIED”)
>>> pdf.setFont(“Courier”, 40)
>>> pdf.drawCentredString(letter[0] / 2, inch *  5, “For 007’s Eyes Only”)
# Close the drawing for current page
>>> pdf.showPage()
# Save the pdf page
>>> pdf.save()
```

Output:

```
@image:pdf.png
@title: PDF Output
```

Using Twitter API

49 You can connect to Twitter easily using the ‘Python-Twitter’ module.

Perform the following steps to install Python-Twitter:

```
$ wget  http://python-twitter.googlecode.com/files/python-twitter-0.6.tar.gz
$ tar xvfz python-twitter*
$ cd python-twitter*
$ sudo python setup.py install
```

Example (fetching followers list):

```
>>> import twitter
# Use you own twitter account here
>>> mytwi = twitter.Api(username=’kunaldeo’,password=’xxxxxx’)
>>> friends = mytwi.GetFriends()
>>> print [u.name for u in friends]
[u’Matt Legend Gemmell’, u’jono wells’, u’The MDN Big Blog’, u’Manish Mandal’, u’iH8sn0w’, u’IndianVideoGamer.com’, u’FakeAaron Hillegass’, u’ChaosCode’, u’nileshp’, u’Frank Jennings’,..’]
```

Doing Yahoo! news search

50 You can use the Yahoo! search SDK to access Yahoo! search APIs from Python.

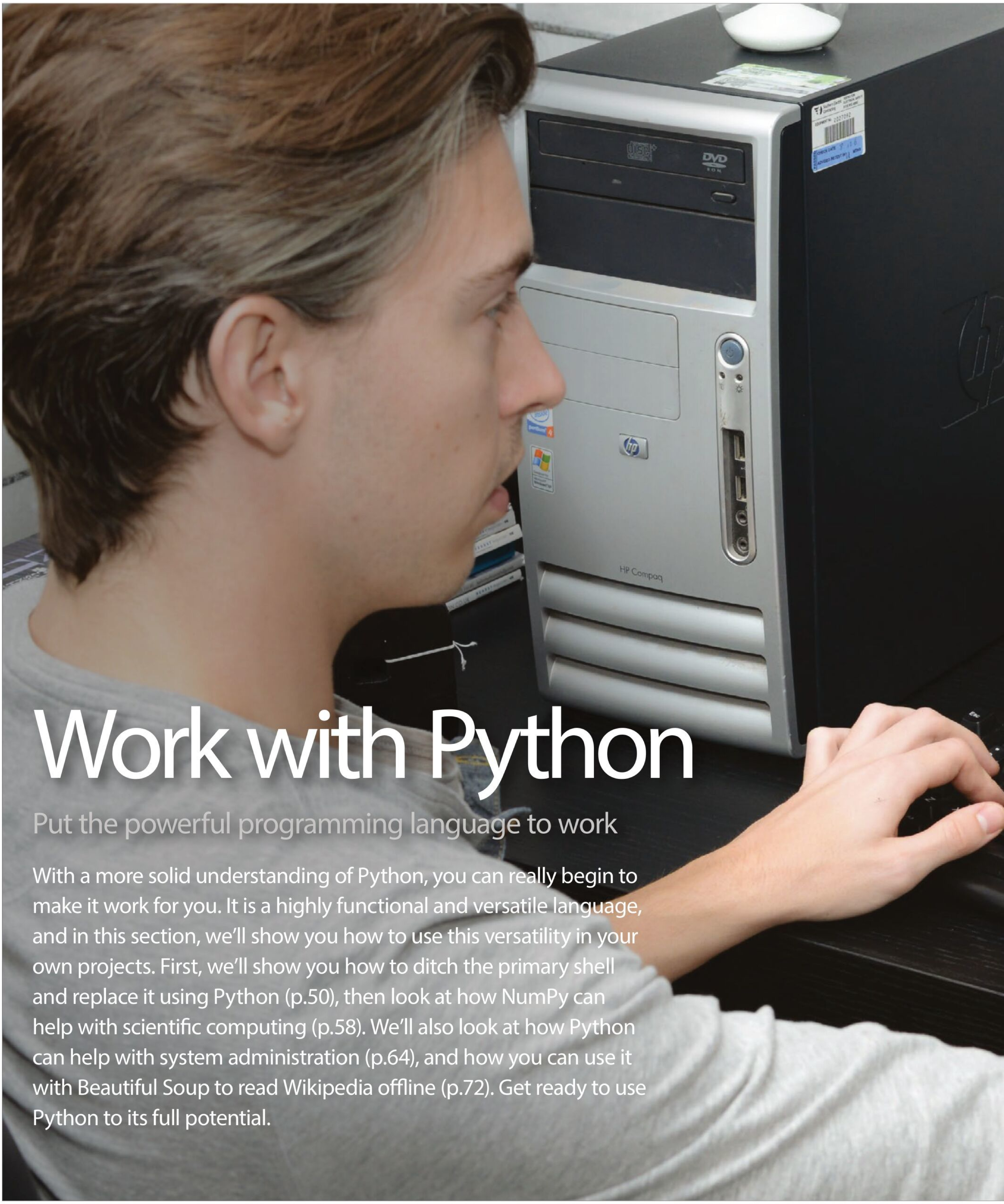
Perform the following steps to install it:

```
$wget http://developer.yahoo.com/download/files/yws- 2.12.zip
$ unzip yws*
$ cd yws*/Python/pYsearch*/
$ sudo python setup.py install
```

Example:

```
# Importing news search API
>>> from yahoo.search.news import NewsSearch
>>> srch = NewsSearch(‘YahooDemo’, query=’London’)
# Fetch Results
>>> info = srch.parse_results()
>>> info.total_results_available
41640
>>> info.total_results_returned
10
>>> for result in info.results:
... print “’%s’, from %s” % (result[‘Title’], result[‘NewsSource’])
...
‘Afghan Handover to Be Planned at London Conference,  Brown Says’, from Bloomberg
.................
```

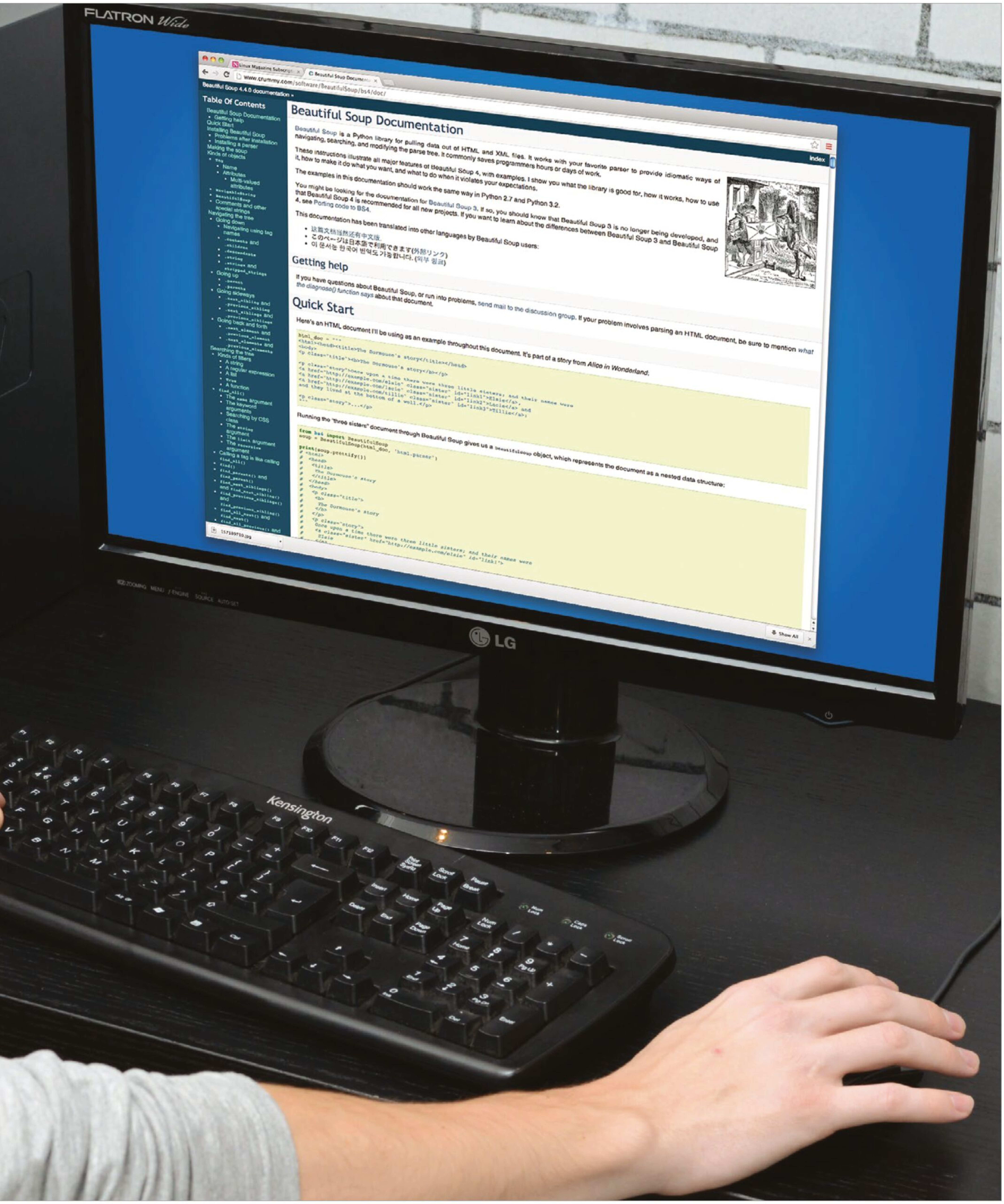
> “There are plenty of services such as IPython and IDLE available to users to help them with Python development”



Work with Python

Put the powerful programming language to work

With a more solid understanding of Python, you can really begin to make it work for you. It is a highly functional and versatile language, and in this section, we'll show you how to use this versatility in your own projects. First, we'll show you how to ditch the primary shell and replace it using Python (p.50), then look at how NumPy can help with scientific computing (p.58). We'll also look at how Python can help with system administration (p.64), and how you can use it with Beautiful Soup to read Wikipedia offline (p.72). Get ready to use Python to its full potential.


FLATRON Wide
Beautiful Soup Documentation
Getting help
Quick Start
LG
Kensington

What you'll need…

Python
www.python.org/doc

Replace your shell with Python

Python is a great programming language, but did you know it can even replace your primary shell?

We all use shell on a daily basis. For most of us, shell is the gateway into our Linux system. For years and even today, Bash has been the default shell for Linux. But it is getting a bit long in the tooth.

No need to be offended: we still believe Bash is the best shell out there when compared to some other UNIX shells such as Korn Shell (KSH), C Shell (CSH) or even TCSH.

This tutorial is not about Bash being incapable, but it is about how to breathe completely new life into the shell to do old things conveniently and new things which were previously not possible, even by a long shot. So, without further delay, let's jump in.

While the Python programming language may require you to write longer commands to accomplish a task (due to the way Python's modules are organised), this is not something to be particularly concerned about. You can easily write aliases to the equivalent of the Bash command that you intend to replace. Most of the time there will be more than one way to do a thing, but you will need to decide which way works best for you.

Python provides support for executing system commands directly (via the os or subprocess module), but where possible we will focus on Python-native implementations here, as this allows us to develop portable code.

SECTION 1: Completing basic shell tasks in Python

1. File management

The Python module shutil provides support for file and directory operations. It provides support for file attributes, directory copying, archiving etc. Let's look at some of its important functions.

`shutil module`

`copy (src,dst)`: Copy the src file to the destination directory. In this mode permissions bits are copied but metadata is not copied.
`copy2 (src,dst)`: Same as copy() but also copies the metadata.
`copytree(src, dst[, symlinks=False[, ignore=None]])`: This is similar to 'cp -r', it allows you to copy an entire directory.
`ignore_patterns (*patterns)`: ignore_patterns is an interesting function that can be used as a callable for copytree(), it allows you to ignore files and directories specified by the glob-style patterns.
`rmtree(path[, ignore_errors[, onerror]])`: rmtree() is used to delete an entire directory.
`move(src,dst)`: Similar to mv command it allows you to recessively move a file or directory to a new location.

Example:

```
from shutil import copytree, ignore_patterns
copytree(source, destination, ignore=ignore_patterns(‘*.pyc’, ‘tmp*’))
```

`make_archive(base_name, format[, root_dir[, base_dir[, verbose[, dry_run[, owner[, group[, logger]]]]]]]`: Think of this as a replacement for tar, zip, bzip etc. make_archive() creates an archive file in the given format such as zip, bztar, tar , gztar. Archive support can be extended via Python modules.

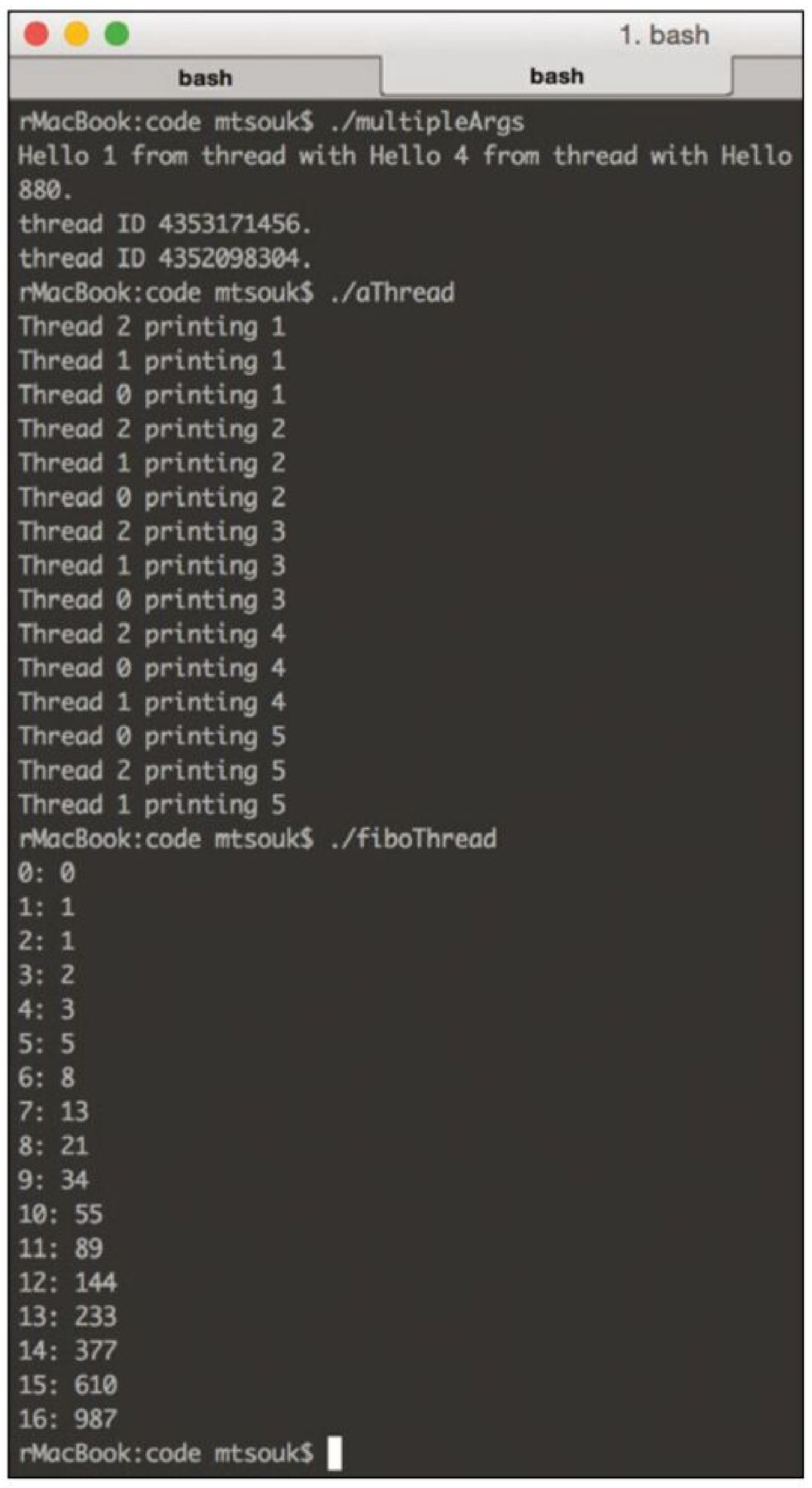
Example:

```
from shutil import make_archive
import os
archive_name = os.path.expanduser(os.path.join(‘~’, ‘ludarchive’))
root_dir = os.path.expanduser(os.path.join(‘~’, ‘.ssh’))
make_archive(archive_name, ‘gztar’, root_dir)
```

```
‘/Users/kunal/ludarchive.tar.gz’
```

2. Interfacing operating system & subprocesses

Python provides two modules to interface with the OS and to manage processes, called os and subprocess. These modules let you interact with the core operating system shell, and work with the environment, processes, users and file descriptors. The subprocess module was introduced to support better management of subprocesses (paalready



```
rMacBook:code mtsouk$ ./multipleArgs
Hello 1 from thread with Hello 4 from thread with Hello
880.
thread ID 4353171456.
thread ID 4352098304.
rMacBook:code mtsouk$ ./aThread
Thread 2 printing 1
Thread 1 printing 1
Thread 0 printing 1
Thread 2 printing 2
Thread 1 printing 2
Thread 0 printing 2
Thread 2 printing 3
Thread 1 printing 3
Thread 0 printing 3
Thread 2 printing 4
Thread 0 printing 4
Thread 1 printing 4
Thread 0 printing 5
Thread 2 printing 5
Thread 1 printing 5
rMacBook:code mtsouk$ ./fiboThread
0: 0
1: 1
2: 1
3: 2
4: 3
5: 5
6: 8
7: 13
8: 21
9: 34
10: 55
11: 89
12: 144
13: 233
14: 377
15: 610
16: 987
rMacBook:code mtsouk$
```

Above You may never need to use Bash again, with some dedicated Python modules at hand in Python and is aimed to replace os.system, os.spawn*, os.popen, popen2.* and commands.* modules.

os module

`environ`: environment represents the OS environment variables in a string object.

Example:

```
import os
os.environ
```

```
{'VERSIONER_PYTHON_PREFER_32_BIT': 'no', 'LC_CTYPE': 'UTF-
8', 'TERM_PROGRAM_VERSION': '297', 'LOGNAME': 'kunaldeo',
'USER': 'kunaldeo', 'PATH': '/System/Library/Frameworks/
Python.framework/Versions/2.7/bin:/Users/kunaldeo/narwhal/
bin:/opt/local/sbin:/usr/local/bin:/usr/bin:/bin:/usr/sbin:/
sbin:/usr/local/bin:/usr/X11/bin:/opt/local/bin:/Applications/
MOTODEV_Studio_For_Android_2.0.0_x86/android_sdk/tools:/
Applications/MOTODEV_Studio_For_Android_2.0.0_x86/android_sdk/
platform-tools:/Volumes/CyanogenModWorkspace/bin', 'HOME':
'/Users/kunaldeo', 'PS1': '\\[\\e[0;32m\\]\\u\\[\\e[m\\] \\
[\\e[1;34m\\]\\w\\[\\e[m\\] \\[\\e[1;32m\\]\\$\\[\\e[m\\] \\
[\\e[1;37m\\]', 'NARWHAL_ENGINE': 'jsc', 'DISPLAY': '/tmp/launch-
s2LUfa/org.x:0', 'TERM_PROGRAM': 'Apple_Terminal', 'TERM':
'xterm-color', 'Apple_PubSub_Socket_Render': '/tmp/launch-
kDul5P/Render', 'VERSIONER_PYTHON_VERSION': '2.7', 'SHLVL': '1',
'SECURITYSESSIONID': '186a5', 'ANDROID_SDK': '/Applications/
MOTODEV_Studio_For_Android_2.0.0_x86/android_sdk','_': '/System/
Library/Frameworks/Python.framework/Versions/2.7/bin/python',
'TERM_SESSION_ID': 'ACFE2492-BB5C-418E-8D4F-84E9CF63B506',
'SSH_AUTH_SOCK': '/tmp/launch-dj6Mk4/Listeners', 'SHELL': '/bin/
bash', 'TMPDIR': '/var/folders/6s/pgknm8b118737mb8psz8x4z80000
gn/T/', 'LSCOLORS': 'ExFxCxDxBxegedabagacad', 'CLICOLOR': '1',
'__CF_USER_TEXT_ENCODING': '0x1F5:0:0', 'PWD': '/Users/kunaldeo',
'COMMAND_MODE': 'unix2003'}
```

You can also find out the value for an environment value:

```
os.environ['HOME']
'/Users/kunaldeo'
```

`putenv(varname,value)` : Adds or sets an environment variable with the given variable name and value.
`getuid()` : Return the current process's user id.
`getlogin()` : Returns the username of currently logged in user
`getpid(pid)` : Returns the process group id of given pid. When used without any parameters it simply returns the current process id.
`getcwd()` : Return the path of the current working directory.
`chdir(path)` : Change the current working directory to the given path.
`listdir(path)` : Similar to ls, returns a list with the content of directories and file available on the given path.

Example:

```
os.listdir(“/home/homer”)
```

```
[‘.gnome2’, ‘.pulse’, ‘.gconf’, ‘.gconfd’, ‘.beagle’,
‘.gnome2_private’, ‘.gksu.lock’, ‘Public’, ‘.ICEauthority’,
‘.bash_history’, ‘.compiz’, ‘.gvfs’, ‘.update-notifier’,
‘.cache’, ‘Desktop’, ‘Videos’, ‘.profile’, ‘.config’, ‘.esd_
auth’, ‘.viminfo’, ‘.sudo_as_admin_successful’, ‘mbox’,
‘.xsession-errors’, ‘.bashrc’, ‘Music’, ‘.dbus’, ‘.local’,
‘.gstreamer-0.10’, ‘Documents’, ‘.gtk-bookmarks’, ‘Downloads’,
‘Pictures’, ‘.pulse-cookie’, ‘.nautilus’, ‘examples.desktop’,
‘Templates’, ‘.bash_logout’]
```

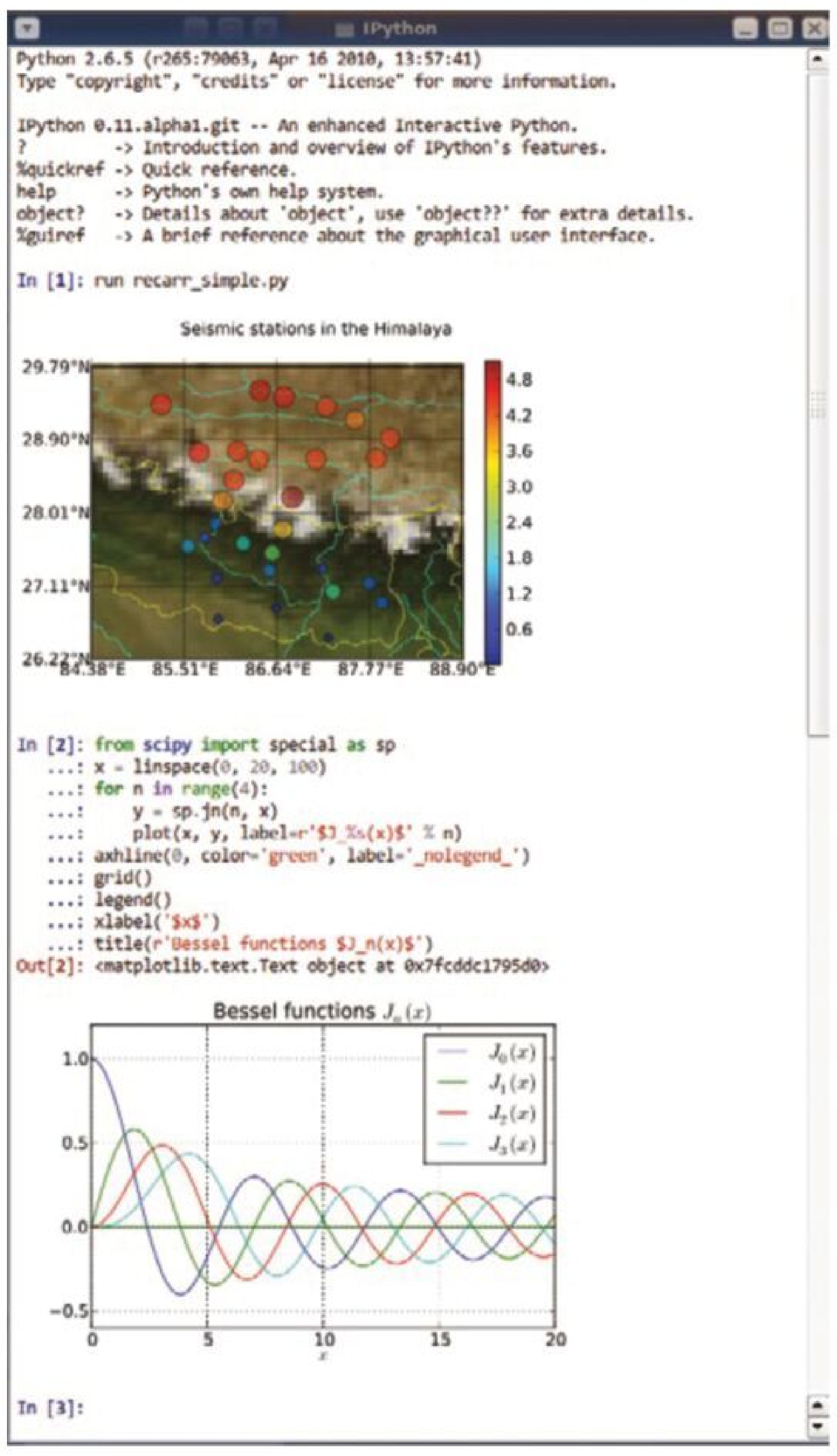
`mkdir(path[, mode])` : Creates a directory with the given path with the numeric code mode. The default mode is 0777.
`makedirs(path[, mode])` : Creates given path (inclusive of all its directories) recursively. The default mode is 0777. :

Example:

```
import os
path = “/home/kunal/greatdir”
os.makedirs( path, 0755 );
```

`rename (old,new)` : The file or directory “old” is renamed to “new” If “new” is a directory, an error will be raised. On Unix and Linux, if “new” exists and is a file, it will be replaced silently if the user has permission..

`renames (old,new)` : Similar to rename but also creates any directories recessively if necessary.



```
Python 2.6.5 (r265:79063, Apr 16 2010, 13:57:41)
Type "copyright", "credits" or "license" for more information.

IPython 0.11.alpha1.git -- An enhanced Interactive Python.
?         -> Introduction and overview of IPython's features.
%quickref -> Quick reference.
help      -> Python's own help system.
object?   -> Details about 'object', use 'object??' for extra details.
%guiref   -> A brief reference about the graphical user interface.

In [1]: run recarr_simple.py

In [2]: from scipy import special as sp
   ...: x = linspace(0, 20, 100)
   ...: for n in range(4):
   ...:     y = sp.jn(n, x)
   ...:     plot(x, y, label=r'$J_%s(x)$' % n)
   ...: axhline(0, color='green', label='_nolegend_')
   ...: grid()
   ...: legend()
   ...: xlabel('$x$')
   ...: title(r'Bessel functions $J_n(x)$')
Out[2]: <matplotlib.text.Text object at 0x7fcddc1795d0>

In [3]:
```

Above A screenshot of the IPython Gt console with GUI capabilities `rmdir(path)` : Remove directory from the path mentioned. If the path already has files you will need to use shutil.rmdtree()

`subprocess:`

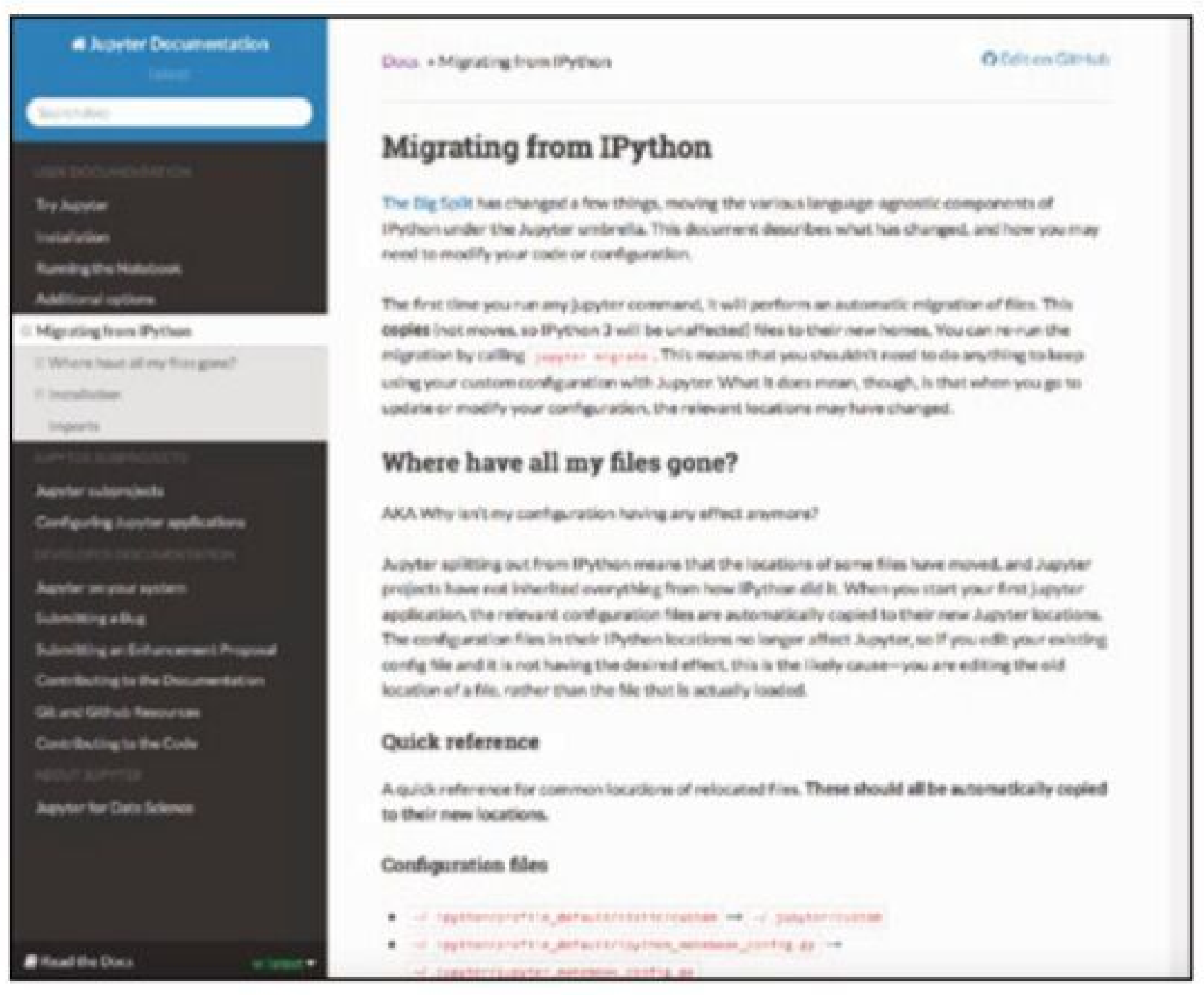
`call(*popenargs, **kwargs)` : Runs the command with arguments. On process completion it returns the returncode attribute.

Example:

```
import subprocess
print subprocess.call([“ls”,”-l”])
```

```
total 3684688
drwx------+    5 kunaldeo   staff     170 Aug 19 01:37 Desktop
drwx------+   10 kunaldeo   staff     340 Jul 26 08:30
                                      Documents
drwx------+   50 kunaldeo   staff     1700 Aug 19 12:50
                                      Downloads
drwx------@ 127 kunaldeo   staff     4318 Aug 19 01:43 Dropbox
drwx------@   42 kunaldeo   staff     1428 Aug 12 15:17 Library
drwx------@    3 kunaldeo   staff     102 Jul  3 23:23 Movies
drwx------+    4 kunaldeo   staff     136 Jul  6 08:32 Music
drwx------+    5 kunaldeo   staff     170 Aug 12 11:26 Pictures
drwxr-xr-x+    5 kunaldeo   staff     170 Jul  3 23:23 Public
-rwxr-xr-x     1 kunaldeo   staff     1886555648 Aug 16 21:02
                                      androidsdk.tar
drwxr-xr-x     5 kunaldeo   staff     170 Aug 16 21:05 sdk
drwxr-xr-x    19 kunaldeo   staff     646 Aug 19 01:47 src
-rw-r--r--     1 root       staff     367 Aug 16 20:36
                                      umbrella0.log
```

STD_INPUT_HANDLE: The standard input device. Initially, this is the console input buffer.
STD_OUTPUT_HANDLE: The standard output device. Initially, this is the active console screen buffer.
STD_ERROR_HANDLE: The standard error device. Initially, this is the active console screen buffer.



Above IPython previously offered a notebook feature, enabling users to create HTML documents where images, code and mathematical formulae were correctly formatted. This has since been split off into a separate (but tightly integrated) service called Jupyter

SECTION 2: IPython: a ready-made Python system shell replacement

In section 1 we have introduced you to the Python modules which allow you to do system shell-related tasks very easily using vanilla Python. Using the same features, you can build a fully featured shell and remove a lot of Python boilerplate code along the way. However, if you are kind of person who wants everything ready-made, you are in luck. IPython provides a powerful and interactive Python shell which you can use as your primary shell. IPython supports Python 2.6 to 2.7 and 3.1 to 3.2 . It supports two type of Python shells: Terminal based and Qt based.

Just to reiterate, IPython is purely implemented in Python and provides a 100% Python-compliant shell interface, so everything that you have learnt in section 1 so far can be run inside IPython without any problems.

IPython is already available in most Linux distributions. Search your distro's repositories to look for it. In case you are not able to find it, you can also install it using easy_install or PyPI.

IPython provides a lot of interesting features which makes it a great shell replacement…

Tab completion: Tab completion provides an excellent way to explore any Python object that you are working with. It also helps you to avoid making typos.

Example :

```
In [3]: import o  {hit tab}
objc     opcode     operator     optparse     os     os2emxpath

In [3]: import os

In [4]: os.p   {hit tab}
os.pardir     os.pathconf_names     os.popen      os.popen4
os.path       os.pathsep            os.popen2     os.putenv
os.pathconf   os.pipe               os.popen3
```

`Built In Object Explorer`: You can add '?' after any Python object to view its details such as Type, Base Class, String Form, Namespace, File and Docstring.

Replace your shell with Python

Example:

```
In [28]: os.path?
Type:        module
Base Class: <type 'module'>
String Form:<module 'posixpath' from '/System/Library/
Frameworks/Python.framework/Versions/2.7/lib/python2.7/
posixpath.pyc'>
Namespace:   Interactive
File:        /System/Library/Frameworks/Python.framework/
Versions/2.7/lib/python2.7/posixpath.py
Docstring:
Common operations on POSIX pathnames.
```

Instead of importing this module directly, import os and refer to this module as os.path. The 'os.path' name is an alias for this module on POSIX systems; on other systems (eg Mac, Windows), os.path provides the same operations in a manner specific to that platform, and is an alias to another module (eg macpath, ntpath).

Some of this can actually be useful on non-POSIX systems too, eg for manipulation of the pathname component of URLs. You can also use double question marks (??) to view the source code for the relevant object.

`Magic functions`: IPython comes with a set of predefined 'magic functions' that you can call with a command-line-style syntax. IPython 'magic' commands are conventionally prefaced by %, but if the flag %automagic is set to on, then you can call magic commands without the %. To view a list of available magic functions, use 'magic function %lsmagic'. They include functions that work with code such as %run, %edit, %macro, %recall etc; functions that affect shell such as %colors, %xmode, %autoindent etc; and others such as %reset, %timeit, %paste etc. Most cool features of IPython are powered using magic functions.

Example:

```
In [45]: %lsmagic
Available magic functions:
%alias %autocall %autoindent %automagic %bookmark %cd
%colors %cpaste %debug %dhist %dirs %doctest_mode %ed
%edit %env %gui %hist %history %install_default_config
%install_profiles %load_ext %loadpy %logoff %logon
%logstart %logstate %logstop %lsmagic %macro %magic
```

```
%page  %paste  %pastebin  %pdb  %pdef  %pdoc  %pfile
%pinfo  %pinfo2  %popd  %pprint  %precision  %profile  %prun
%psearch  %psource  %pushd  %pwd  %pycat  %pylab  %quickref
%recall  %rehashx  %reload_ext  %rep  %rerun  %reset
%reset_selective  %run  %save  %sc  %sx  %tb  %time  %timeit
%unalias  %unload_ext  %who  %who_ls  %whos  %xdel  %xmode
```

Automagic is OFF, % prefix IS needed for magic functions. To view help on any Magic Function, call '%somemagic?' to read its docstring.

Python script execution and runtime code editing: You can use %run to run any Python script. You can also control-run the Python script with pdb debugger using -d, or pdn profiler using -p. You can also edit a Python script using the %edit command which opens the given Python script in the editor defined by the $EDITOR environment variable.

`Shell command support`: To just run a shell command, prefix the command with ! .

Example :

```
In [5]: !ps
  PID TTY         TIME   CMD
 4508 ttys000    0:00.07 -bash
84275 ttys001    0:00.03 -bash
17958 ttys002    0:00.18 -bash

In [8]: !clang prog.c -o prog
prog.c:2:1: warning: type specifier missing, defaults to
'int' [-Wimplicit-int]
main()
^~~~
1 warning generated.
```

`Qt console` : IPython comes with a Qt-based console. This provides features only available in a GUI, like inline figures, multiline editing with syntax highlighting, and graphical calltips. Start the Qt console with:

```
$ ipython qtconsole
```

If you get errors about missing modules, ensure that you have installed dependent packages – PyQt, pygments, pyexpect and ZeroMQ.

Conclusion

As you can see, it's easy to tailor Python for all your shell environment needs. Python modules like os, subprocess and shutil are available at your disposal to do just about everything you need using Python. IPython turns this whole experience into an even more complete package. You get to do everything a standard Python shell does and with much more convenient features. IPython's magic functions really do provide a magical Python shell experience. So next time you open a Bash session, think again: why settle for gold when platinum is a step away?

What you'll need…

NumPy
www.numpy.org

SciPy
www.scipy.org

Matplotlib
www.matplotlib.org

Scientific computing with NumPy

Make some powerful calculations with NumPy, SciPy and Matplotlib

NumPy is the primary Python package for performing scientific computing. It has a powerful N-dimensional array object, tools for integrating C/C++ and Fortran code, linear algebra, Fourier transform, and random number capabilities, among other things. NumPy also supports broadcasting, which is a clever way for universal functions to deal in a meaningful way with inputs that do not have exactly the same form.

Apart from its capabilities, the other advantage of NumPy is that it can be integrated into Python programs. In other words, you may get your data from a database, the output of another program, an external file or an HTML page and then process it using NumPy.

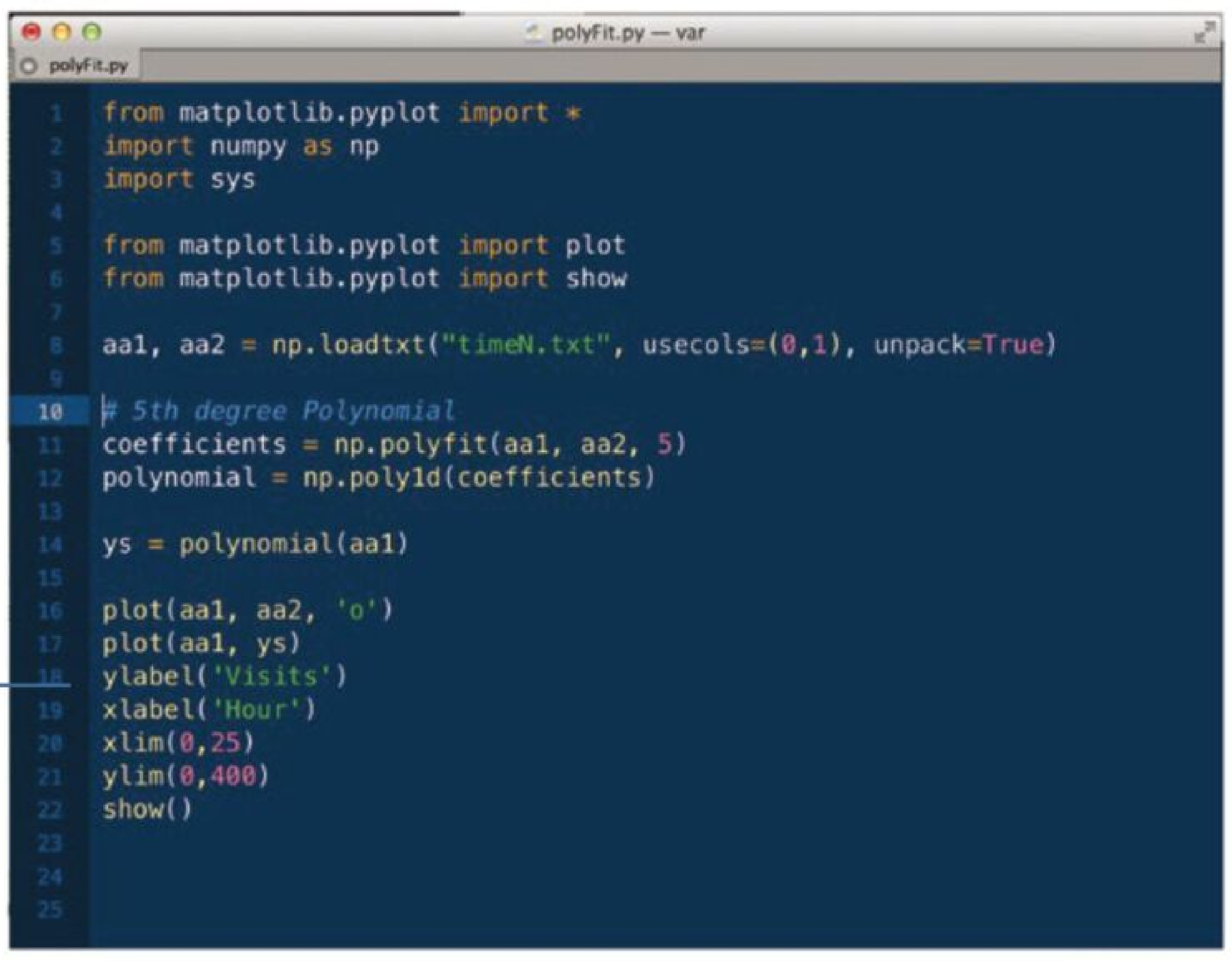
This article will show you how to install NumPy, make calculations, plot data, read and write external files, and it will introduce you to some Matplotlib and SciPy packages that work well with NumPy.

NumPy also works with Pygame, a Python package for creating games, though explaining its use is unfortunately beyond of the scope of this article.

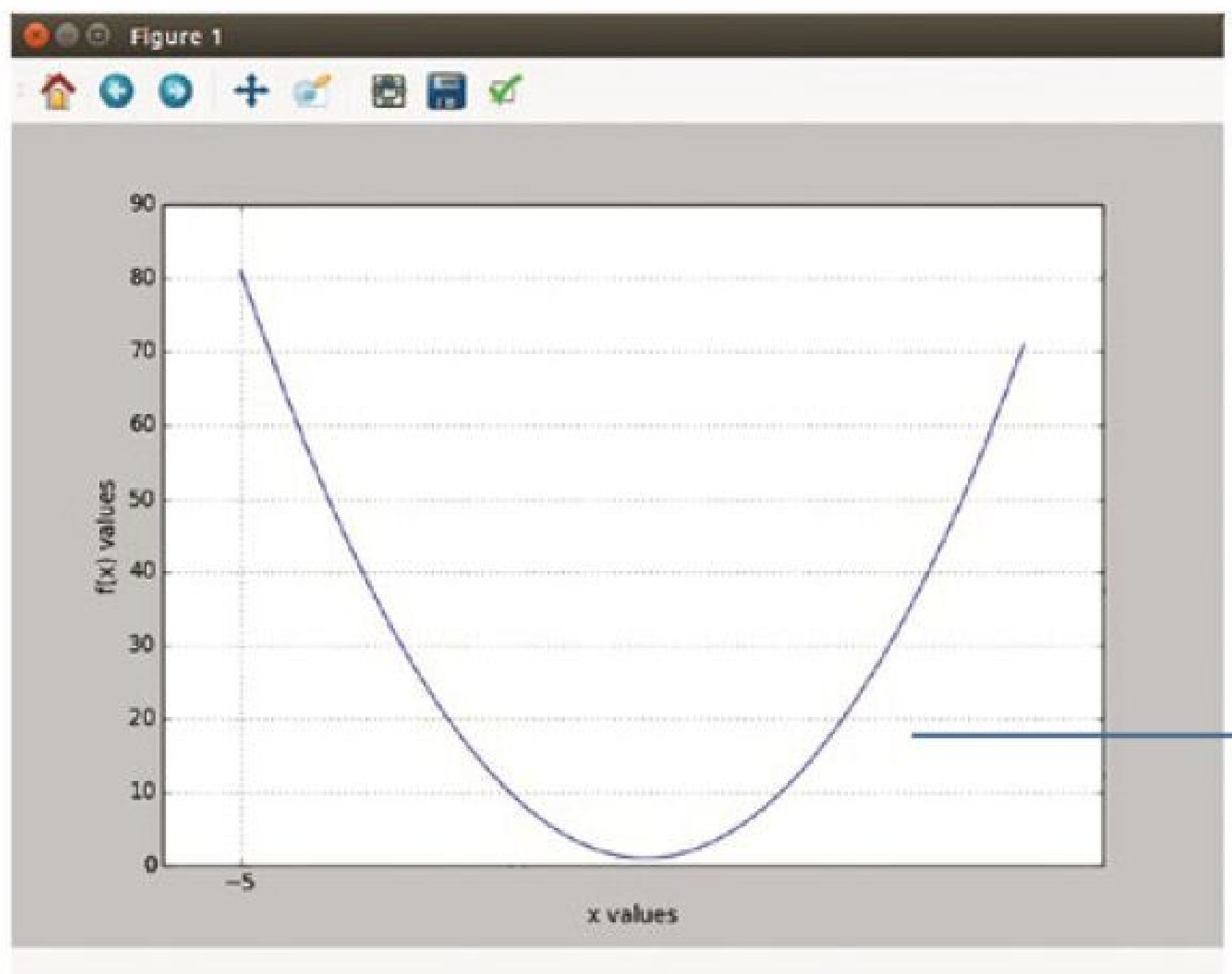
It is considered good practice to try the various NumPy commands inside the Python shell before putting them into Python programs. The examples in this article use either Python shell or iPython.

> "Apart from its capabilities, the other advantage of NumPy is that it can be integrated into Python programs"

A simple Python program for Polynomial Fitting

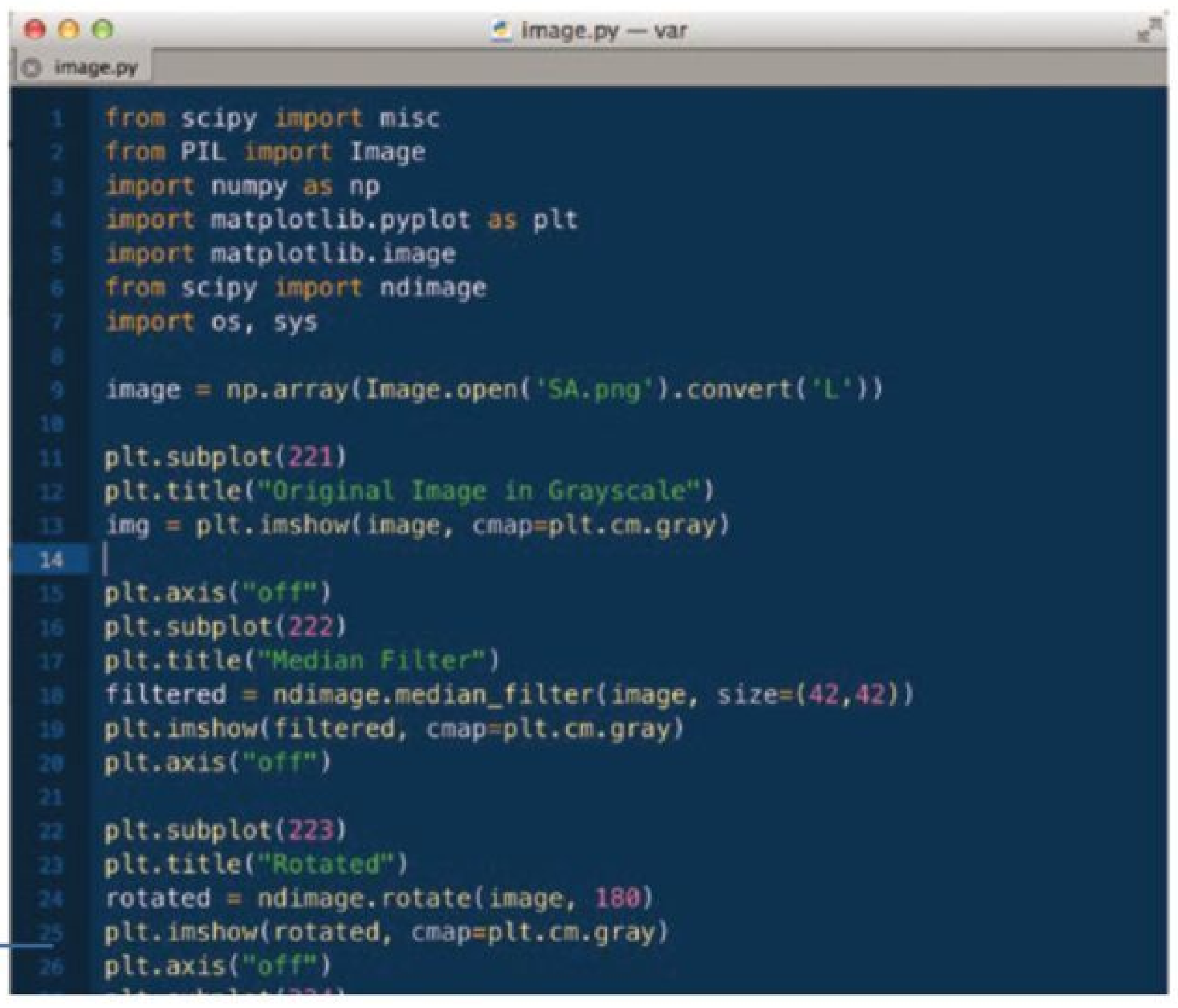


```
from matplotlib.pyplot import *
import numpy as np
import sys

from matplotlib.pyplot import plot
from matplotlib.pyplot import show

aa1, aa2 = np.loadtxt("timeN.txt", usecols=(0,1), unpack=True)

# 5th degree Polynomial
coefficients = np.polyfit(aa1, aa2, 5)
polynomial = np.poly1d(coefficients)

ys = polynomial(aa1)

plot(aa1, aa2, 'o')
plot(aa1, ys)
ylabel('Visits')
xlabel('Hour')
xlim(0,25)
ylim(0,400)
show()
```

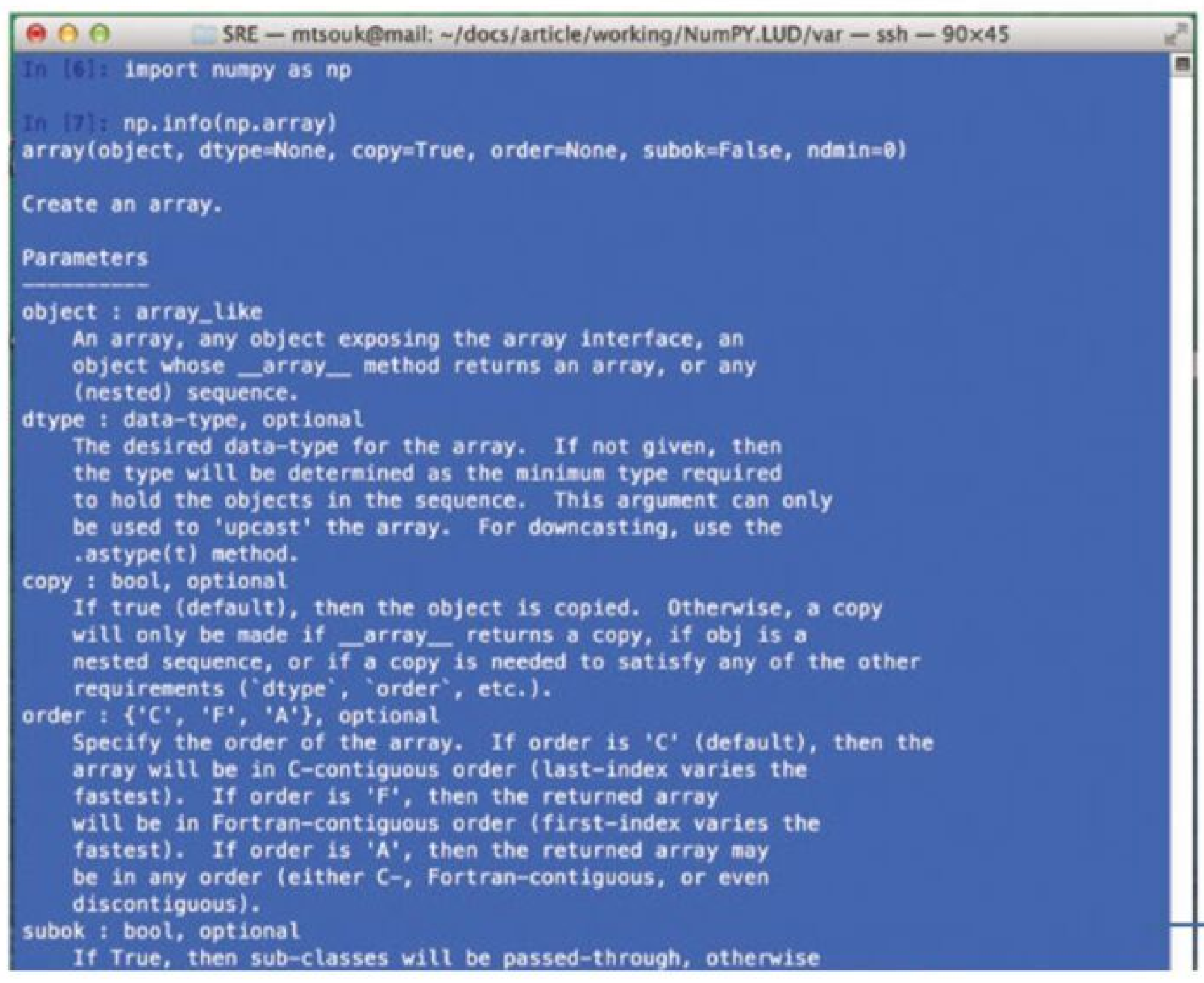


Matplotlib generated output

A Python script that uses SciPy to process an image



```
from scipy import misc
from PIL import Image
import numpy as np
import matplotlib.pyplot as plt
import matplotlib.image
from scipy import ndimage
import os, sys

image = np.array(Image.open('SA.png').convert('L'))

plt.subplot(221)
plt.title("Original Image in Grayscale")
img = plt.imshow(image, cmap=plt.cm.gray)

plt.axis("off")
plt.subplot(222)
plt.title("Median Filter")
filtered = ndimage.median_filter(image, size=(42,42))
plt.imshow(filtered, cmap=plt.cm.gray)
plt.axis("off")

plt.subplot(223)
plt.title("Rotated")
rotated = ndimage.rotate(image, 180)
plt.imshow(rotated, cmap=plt.cm.gray)
plt.axis("off")
```


SRE — mtsouk@mail: ~/docs/article/working/NumPY.LUD/var — ssh — 90×45

```
In [6]: import numpy as np

In [7]: np.info(np.array)
array(object, dtype=None, copy=True, order=None, subok=False, ndmin=0)

Create an array.

Parameters
----------
object : array_like
    An array, any object exposing the array interface, an
    object whose __array__ method returns an array, or any
    (nested) sequence.
dtype : data-type, optional
    The desired data-type for the array.  If not given, then
    the type will be determined as the minimum type required
    to hold the objects in the sequence.  This argument can only
    be used to 'upcast' the array.  For downcasting, use the
    .astype(t) method.
copy : bool, optional
    If true (default), then the object is copied.  Otherwise, a copy
    will only be made if __array__ returns a copy, if obj is a
    nested sequence, or if a copy is needed to satisfy any of the other
    requirements (`dtype`, `order`, etc.).
order : {'C', 'F', 'A'}, optional
    Specify the order of the array.  If order is 'C' (default), then the
    array will be in C-contiguous order (last-index varies the
    fastest).  If order is 'F', then the returned array
    will be in Fortran-contiguous order (first-index varies the
    fastest).  If order is 'A', then the returned array may
    be in any order (either C-, Fortran-contiguous, or even
    discontiguous).
subok : bool, optional
    If True, then sub-classes will be passed-through, otherwise
```

Finding help is easy

Installing NumPy

01 Most Linux distributions have a ready-to-install package you can use. After installation, you can find out the NumPy version you are using by executing the following:

```
$ python
Python 2.7.3 (default, Mar 13 2014, 11:03:55)
[GCC 4.7.2] on linux2
Type “help”, “copyright”, “credits” or “license” for more information.
>>> numpy.version.version
Traceback (most recent call last):
  File “<stdin>”, line 1, in <module>
NameError: name ‘numpy’ isnot defined
>>> import numpy
>>> numpy.version.version
‘1.6.2’
>>>
```

Not only have you found the NumPy version but you also know that NumPy is properly installed.

About NumPy

02 Despite its simplistic name, NumPy is a powerful Python package that is mainly for working with arrays and matrices. There are many ways to create an array but the simplest one is to make use of the array() function:

```
>>> oneD = array([1,2,3,4])
```

The aforementioned command creates a one-dimensional array. If you want to create a two-dimensional array, you can use the array() function as follows:

```
>>> twoD = array([ [1,2,3],
...                [3,3,3],
...                [-1,-0.5,4],
...                [0,1,0]] )
```

You can also create arrays with some more dimensions.

Making simple calculations using NumPy

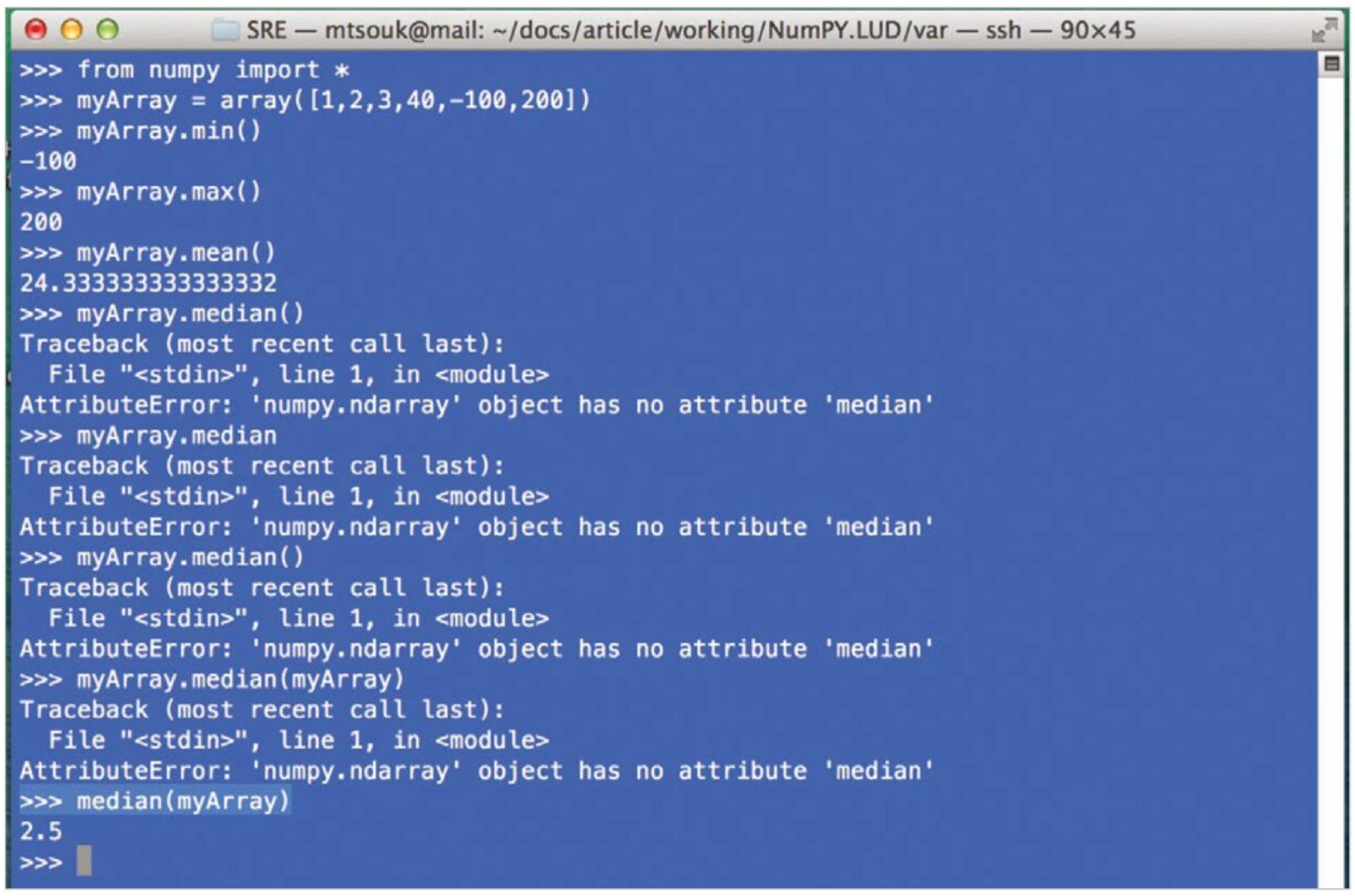
03 Given an array named myArray, you can find the minimum and maximum values in it by executing the following commands:

```
>>> myArray.min()
>>> myArray.max()
```

Should you wish to find the mean value of all array elements, you can run the next command:

```
>>> myArray.mean()
```

Similarly, you can find the median of the


SRE — mtsouk@mail: ~/docs/article/working/NumPY.LUD/var — ssh — 90×45

```
>>> from numpy import *
>>> myArray = array([1,2,3,40,-100,200])
>>> myArray.min()
-100
>>> myArray.max()
200
>>> myArray.mean()
24.333333333333332
>>> myArray.median()
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
AttributeError: 'numpy.ndarray' object has no attribute 'median'
>>> myArray.median
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
AttributeError: 'numpy.ndarray' object has no attribute 'median'
>>> myArray.median()
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
AttributeError: 'numpy.ndarray' object has no attribute 'median'
>>> myArray.median(myArray)
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
AttributeError: 'numpy.ndarray' object has no attribute 'median'
>>> median(myArray)
2.5
>>> 
```

array by running the following Python command:

```
>>> median(myArray)
```

The median value of a set is an element that divides the data set into two subsets (left and right subsets) with the same number of elements. If the data set has an odd number of elements, then the median is part of the data set. On the other side, if the data set has an even number of elements, then the median is the mean value of the two centre elements of the sorted data set.

Using arrays with NumPy

04 NumPy not only embraces the indexing methods used in typical Python for strings and lists but also extends them. If you want to select a given element from an array, you can use the following notation:

```
>>> twoD[1,2]
```

You can also select a part of an array (a slice) using the following notation:

```
>>> twoD[:1,1:3]
```

Finally, you can convert an array into a Python list using the tolist() function.

Reading files

05 Imagine that you have just extracted information from an Apache log file using AWK and you now want to go and process the text file using NumPy.

The following AWK code finds out the total number of requests per hour:

```
$ cat access.log | cut -d[
-f2 | cut -d] -f1 | awk -F:
‘{print $2}’ | sort -n | uniq
-c | awk ‘{print $2, $1}’ >
timeN.txt
```

The format of the text file (timeN.txt) with the data is the following:

```
00 191
01 225
02 121
03 104
```

Reading the timeN.txt file and assigning it to a new array variable can be done as follows:

```
aa = np.loadtxt(“timeN.txt”)
```

Writing to files

06 Writing variables to a file is largely similar to reading a file. If you have an array variable named aa1, you can easily save its contents into a file called aa1.txt by using the following command:

> “When you apply a function to an array, the function is automatically applied to all of the array elements”

```
In [17]: np.savetxt(“aa1.txt”,
aa1)
```

As you can easily imagine, you can read the contents of aa1.txt later by using the loadtxt() function.

Common functions

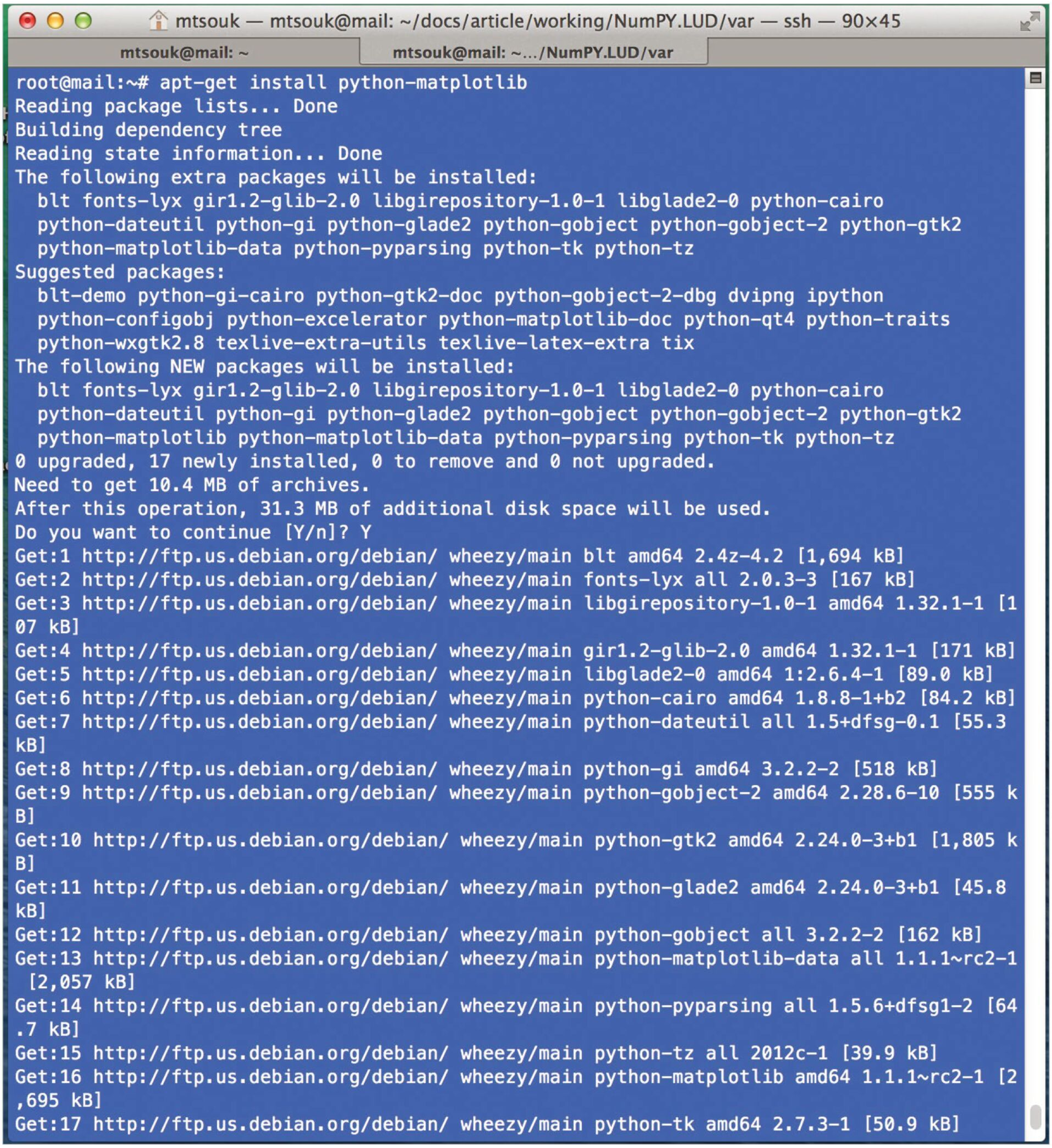
07 NumPy supports many numerical and statistical functions. When you apply a function to an array, the function is then automatically applied to all of the array elements.

When working with matrices, you can find the inverse of a matrix AA by typing “AA.I”. You can also find its eigenvalues by typing “np.linalg.eigvals(AA)” and its eigenvector by typing “np.linalg.eig(BB)”.

Working with matrices

08 A special subtype of a two-dimensional NumPy array is a matrix. A matrix is like an array except that matrix multiplication replaces element-by-element multiplication. Matrices are generated using the matrix (or mat) function as follows:

```
In [2]: AA = np.mat(‘0 1 1; 1
1 1; 1 1 1’)
```


mtsouk — mtsouk@mail: ~/docs/article/working/NumPY.LUD/var — ssh — 90×45
mtsouk@mail: ~
mtsouk@mail: ~.../NumPY.LUD/var

```
root@mail:~# apt-get install python-matplotlib
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following extra packages will be installed:
  blt fonts-lyx gir1.2-glib-2.0 libgirepository-1.0-1 libglade2-0 python-cairo
  python-dateutil python-gi python-glade2 python-gobject python-gobject-2 python-gtk2
  python-matplotlib-data python-pyparsing python-tk python-tz
Suggested packages:
  blt-demo python-gi-cairo python-gtk2-doc python-gobject-2-dbg dvipng ipython
  python-configobj python-excelerator python-matplotlib-doc python-qt4 python-traits
  python-wxgtk2.8 texlive-extra-utils texlive-latex-extra tix
The following NEW packages will be installed:
  blt fonts-lyx gir1.2-glib-2.0 libgirepository-1.0-1 libglade2-0 python-cairo
  python-dateutil python-gi python-glade2 python-gobject python-gobject-2 python-gtk2
  python-matplotlib python-matplotlib-data python-pyparsing python-tk python-tz
0 upgraded, 17 newly installed, 0 to remove and 0 not upgraded.
Need to get 10.4 MB of archives.
After this operation, 31.3 MB of additional disk space will be used.
Do you want to continue [Y/n]? Y
Get:1 http://ftp.us.debian.org/debian/ wheezy/main blt amd64 2.4z-4.2 [1,694 kB]
Get:2 http://ftp.us.debian.org/debian/ wheezy/main fonts-lyx all 2.0.3-3 [167 kB]
Get:3 http://ftp.us.debian.org/debian/ wheezy/main libgirepository-1.0-1 amd64 1.32.1-1 [1
07 kB]
Get:4 http://ftp.us.debian.org/debian/ wheezy/main gir1.2-glib-2.0 amd64 1.32.1-1 [171 kB]
Get:5 http://ftp.us.debian.org/debian/ wheezy/main libglade2-0 amd64 1:2.6.4-1 [89.0 kB]
Get:6 http://ftp.us.debian.org/debian/ wheezy/main python-cairo amd64 1.8.8-1+b2 [84.2 kB]
Get:7 http://ftp.us.debian.org/debian/ wheezy/main python-dateutil all 1.5+dfsg-0.1 [55.3
kB]
Get:8 http://ftp.us.debian.org/debian/ wheezy/main python-gi amd64 3.2.2-2 [518 kB]
Get:9 http://ftp.us.debian.org/debian/ wheezy/main python-gobject-2 amd64 2.28.6-10 [555 k
B]
Get:10 http://ftp.us.debian.org/debian/ wheezy/main python-gtk2 amd64 2.24.0-3+b1 [1,805 k
B]
Get:11 http://ftp.us.debian.org/debian/ wheezy/main python-glade2 amd64 2.24.0-3+b1 [45.8
kB]
Get:12 http://ftp.us.debian.org/debian/ wheezy/main python-gobject all 3.2.2-2 [162 kB]
Get:13 http://ftp.us.debian.org/debian/ wheezy/main python-matplotlib-data all 1.1.1~rc2-1
 [2,057 kB]
Get:14 http://ftp.us.debian.org/debian/ wheezy/main python-pyparsing all 1.5.6+dfsg1-2 [64
.7 kB]
Get:15 http://ftp.us.debian.org/debian/ wheezy/main python-tz all 2012c-1 [39.9 kB]
Get:16 http://ftp.us.debian.org/debian/ wheezy/main python-matplotlib amd64 1.1.1~rc2-1 [2
,695 kB]
Get:17 http://ftp.us.debian.org/debian/ wheezy/main python-tk amd64 2.7.3-1 [50.9 kB]
```

You can add matrices named AA and BB by typing AA + BB. Similarly, you can multiply them by typing AA * BB.

Plotting with Matplotlib

09 The first move you should make is to install Matplotlib. As you can see, Matplotlib has many dependencies that you should also install. The first thing you will learn is how to plot a polynomial function. The necessary commands for plotting the 3x^2-x+1 polynomial are the following:

```
import numpy as np
import matplotlib.pyplot
```

> "Try the various NumPy commands inside the Python shell"

```
as plt
myPoly = np.poly1d(np.array([3, -1, 1]).astype(float))
x = np.linspace(-5, 5, 100)
y = myPoly(x)
plt.xlabel(‘x values’)
plt.ylabel(‘f(x) values’)
xticks = np.arange(-5, 5, 10)
yticks = np.arange(0, 100, 10)
plt.xticks(xticks)
plt.yticks(yticks)
plt.grid(True)
plt.plot(x,y)
```

The variable that holds the polynomial is myPoly. The range of values that will be plotted for x is defined using “x = np.linspace(-5, 5, 100)”. The other important variable is y, which calculates and holds the values of f(x) for each x value.

It is important that you start ipython using the “ipython --pylab=qt” parameters in order to see the output on your screen. If you are interested in plotting polynomial functions, you should experiment more, as NumPy can also calculate the derivatives of a function and plot multiple functions in the same output.

About SciPy

10 SciPy is built on top of NumPy and is significantly more advanced than NumPy. It supports numerical integration, optimisations, signal processing, image and audio processing, and statistics. For reference, the example below uses just one small part of the scipy.stats package about statistics.

```
In [36]: from scipy.stats import poisson, lognorm
In [37]: mySh = 10;
In [38]: myMu = 10;
In [39]: ln = lognorm(mySh)
In [40]: p = poisson(myMu)
In [41]: ln.rvs((10,))
Out[41]:
array([  9.29393114e-02,   1.15957068e+01,   9.78411983e+01,
         8.26370734e-07,   5.64451441e-03,   4.61744055e-09,
         4.98471222e-06,   1.45947948e+02,   9.25502852e-06,
         5.87353720e-02])
In [42]: p.rvs((10,))
Out[42]: array([12, 11,  9,  9,  9, 10,  9,  4, 13,  8])
In [43]: ln.pdf(3)
Out[43]: 0.013218067177522842
```

The example uses two statistics distributions and may be difficult to understand, but it is presented in order to give you a better taste of SciPy commands.

“For plotting polynomial functions, experiment more”

Using SciPy for image processing

11 Now we will show you how to process and transform a PNG image using SciPy. The most important part of the code is the following line:

```
image = np.array(Image.open(‘SA.png’).convert(‘L’))
```

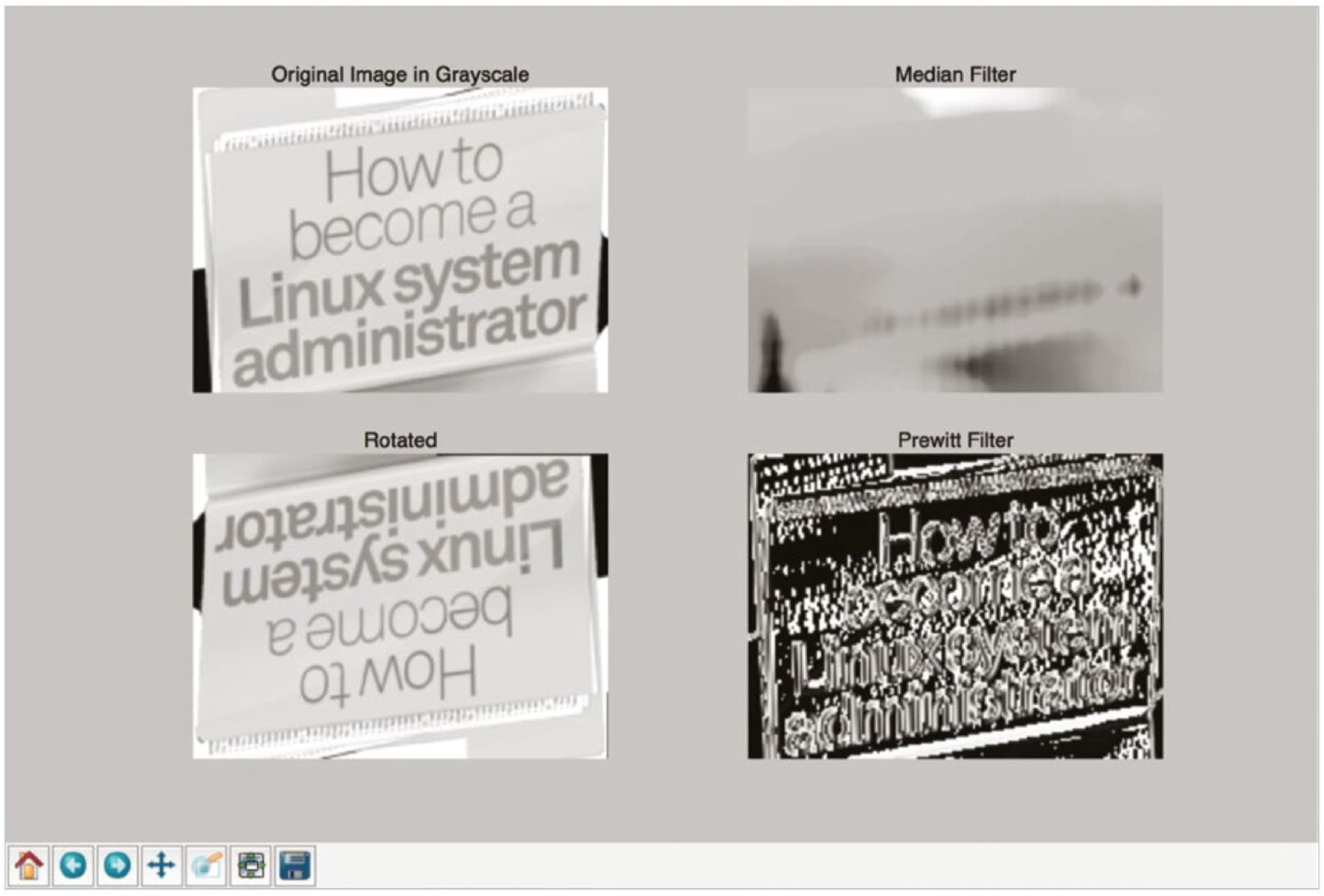
This line allows you to read a usual PNG file and convert it into a NumPy array for additional processing. The program will also separate the output into four parts and displays a different image for each of these four parts.

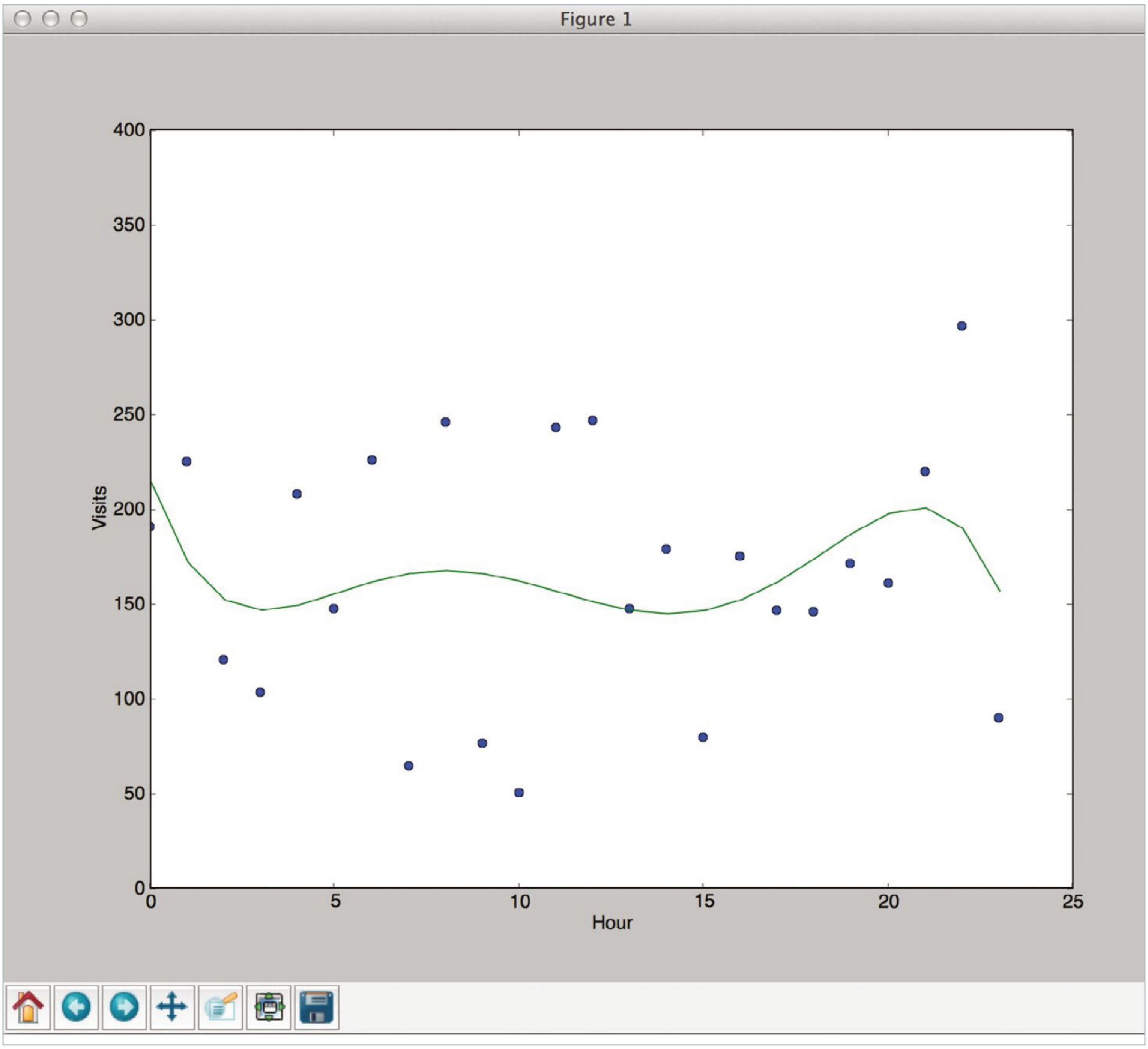
Other useful functions

12 It is very useful to be able to find out the data type of the elements in an array; it can be done using the dtype() function. Similarly, the ndim() function returns the number of dimensions of an array.

When reading data from external files, you can save their data columns into separate variables using the following method:

```
In [10]: aa1,aa2 =
```


Original Image in Grayscale
Median Filter
Rotated
Prewitt Filter
How to become a Linux system administrator



Above Fitting to Polynomials

```
np.loadtxt("timeN.txt",
usecols=(0,1), unpack=True)
```

The aforementioned command saves column 1 into variable aa1 and column 2 into variable aa2. The "unpack=True" allows the data to be assigned to two different variables. Please note that the numbering of columns starts with 0.

Fitting to polynomials

13 The NumPy polyfit() function tries to fit a set of data points to a polynomial. The data was found from the timeN.txt file, created earlier.

The Python script uses a fifth degree polynomial, but if you want to use a different degree instead then you only have to change the following line:

```
coefficients = np.polyfit(aa1,
aa2, 5)
```

Array broadcasting in NumPy

14 To close, we will talk more about array broadcasting because it is a very useful characteristic. First, you should know that array broadcasting has a rule: in order for two arrays to be considered for array broadcasting, "the size of the trailing axes for both arrays in an operation must either be the same size or one of them must be one."

Put simply, array broadcasting allows NumPy to "change" the dimensions of an array by filling it with data in order to be able to do calculations with another array. Nevertheless, you cannot stretch both dimensions of an array to do your job.

What you'll need…

Python-devel
Python development libraries, required for compiling third-party Python module

setuptools
setuptools allows you to download, build, install, upgrade, and uninstall Python packages with ease

Note

This is written for the Python 2.X series, as it is still the most popular and default Python distribution across all the platforms (including all Linux distros, BSDs and Mac OS X).

Python for system administrators

Learn how Python can help by daring to replace the usual shell scripting…

System administration is an important part of our computing environment. It does not matter whether you are managing systems at your work our home. Linux, being a UNIX-based operating system, already has everything a system administrator needs, such as the world-class shells (not just one but many, including Bash, csh, zsh etc), handy tools, and many other features which make the Linux system an administrator's dream. So why do we need Python when Linux already has everything built-in? Being a dynamic scripting language, Python is very easy to read and learn. That's just not us saying that, but many Linux distributions actually use Python in core administrative parts. For example, Red Hat (and Fedora) system setup tool Anaconda is written in Python (read this line again, got the snake connection?). Also, tools like GNU Mailman, CompizConfig Settings Manager (CCSM) and hundreds of tiny GUI and non-GUI configuration tools are written using Python. Python does not limit you on the choice of user interface to follow – you can build command-line, GUI and web apps using Python. This way, it has got covered almost all the possible interfaces. Here we will look into executing sysadmin-related tasks using Python.

Parsing configuration files

Configuration files provide a way for applications to store various settings. In order to write a script that allows you to modify settings of a particular application, you should be able to parse the configuration file of the application. In this section we learn how to parse INI-style configuration files. Although old, the INI file format is very popular with much modern open source software, such as PHP and MySQL.

Excerpt for php.ini configuration file:

```
[PHP]
engine = On
```

```
zend.ze1_compatibility_mode = Off
short_open_tag = On
asp_tags = Off
precision     =  14
y2k_compliance = On
output_buffering = 4096
;output_handler =
zlib.output_compression = Off

[MySQL]
; Allow or prevent persistent links.
mysql.allow_persistent = On
mysql.max_persistent = 20
mysql.max_links = -1
mysql.default_port = 3306
mysql.default_socket =
mysql.default_host = localhost
mysql.connect_timeout = 60
mysql.trace_mode = Off
```

Python provides a built-in module called ConfigParser (known as configparser in Python 3.0). You can use this module to parse and create configuration files.

@code: writeconfig.py
@description: The following demonstrates adding MySQL section to the php.ini file.
@warning: Do not use this script with the actual php.ini file, as it's not designed to handle all aspects of a complete php.ini file.

```
import ConfigParser
config = ConfigParser.RawConfigParser()

config.add_section(‘MySQL’)
config.set(‘MySQL’,’mysql.trace_mode’,’Off’)
config.set(‘MySQL’,’mysql.connect_
timeout’,’60’)
config.set(‘MySQL’,’mysql.default_
host’,’localhost’)
config.set(‘MySQL’,’mysql.default_
port’,’3306’)
config.set(‘MySQL’,’mysql.allow_persistent’,
‘On’ )
config.set(‘MySQL’,’mysql.max_
persistent’,’20’)

with open(‘php.ini’, ‘ap’) as configfile:
     config.write(configfile)

Output:php.ini
[MySQL]
mysql.max_persistent = 20
mysql.allow_persistent = On
mysql.default_port = 3306
mysql.default_host = localhost
mysql.trace_mode = Off
mysql.connect_timeout = 60

@code: parseconfig.py
@description: Parsing and updating the
config  file
import ConfigParser
config = ConfigParser.ConfigParser()
config.read(‘php.ini’)
# Print config values
print config.get(‘MySQL’,’mysql.default_
host’)
print config.get(‘MySQL’,’mysql.default_
port’)
config.remove_option(‘MySQL’,’mysql.trace_
mode’)
with open(‘php.ini’, ‘wb’) as configfile:
     config.write(configfile)
```

Parsing JSON data

JSON (also known as JavaScript Object Notation) is a lightweight modern data-interchange format. JSON is an open standard under ECMA-262. It is a text format and is completely language-independent. JSON is also used as the configuration file format for modern applications such as Mozilla Firefox and Google Chrome. JSON is also very popular with modern web services such as Facebook, Twitter, Amazon EC2 etc. In this section we will use the Python module ‘simplejson’ to access Yahoo Search (using the Yahoo Web Services API), which outputs JSON data.

To use this section, you should have the following:

1. Python module: simplejson.

Note: You can install Python modules using the command ‘easy_install <module name>’. This command assumes that you have a working internet connection.

2. Yahoo App ID:

The Yahoo App ID can be created from https://developer.apps.yahoo.com/dashboard/createKey.html. The Yahoo App ID will be generated on the next page. See the screenshot below for details.

simplejson is very easy to use. In the following example we will use the capability of mapping JSON data structures directly to Python data types. This gives us direct access to the JSON data without developing any XML parsing code.

JSON PYTHON DATA MAPPING

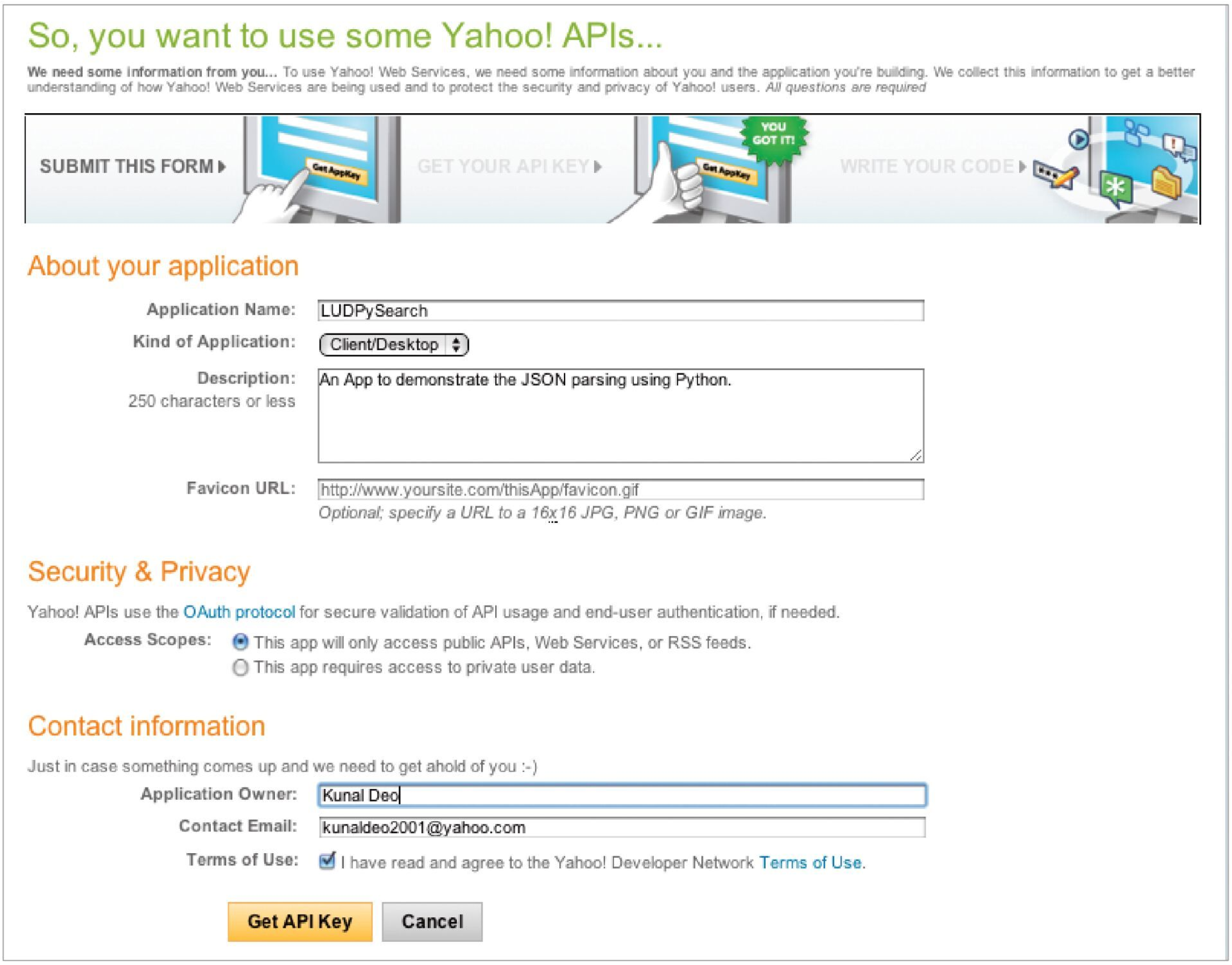
JSON	Python
object	dict
array	list
string	unicode
number (int)	int, long
number (real)	float
TRUE	TRUE
FALSE	FALSE
null	None

For this section we will use the simplejson.load function, which allows us to deserialise a JSON object into a Python object.

```
@code: LUDSearch.py
import simplejson, urllib
APP_ID = ‘xxxxxxxx’ # Change this to
your APP ID
SEARCH_BASE = ‘http://search.yahooapis.
com/WebSearchService/V1/webSearch’

class YahooSearchError(Exception):
    pass

def search(query, results=20, start=1,
**kwargs):
    kwargs.update({
        ‘appid’: APP_ID,
        ‘query’: query,
        ‘results’: results,
        ‘start’: start,
        ‘output’: ‘json’
    })
    url = SEARCH_BASE + ‘?’ + urllib.
urlencode(kwargs)
    result = simplejson.load(urllib.
urlopen(url))
    if ‘Error’ in result:
        # An error occurred; raise an
exception
        raise YahooSearchError,
result[‘Error’]
    return result[‘ResultSet’]
```

Let’s use the code listed above from the Python shell to see how it works. Change to the directory where you have saved the LUDYSearch.py and open a Python shell.

```
@code: Python Shell Output. Lines
```



So, you want to use some Yahoo! APIs...

We need some information from you... To use Yahoo! Web Services, we need some information about you and the application you're building. We collect this information to get a better understanding of how Yahoo! Web Services are being used and to protect the security and privacy of Yahoo! users. *All questions are required*

About your application

Application Name:	LUDPySearch
Kind of Application:	Client/Desktop
Description: 250 characters or less	An App to demonstrate the JSON parsing using Python.
Favicon URL:	http://www.yoursite.com/thisApp/favicon.gif *Optional; specify a URL to a 16x16 JPG, PNG or GIF image.*

Security & Privacy

Yahoo! APIs use the OAuth protocol for secure validation of API usage and end-user authentication, if needed.

Access Scopes:
● This app will only access public APIs, Web Services, or RSS feeds.
○ This app requires access to private user data.

Contact information

Just in case something comes up and we need to get ahold of you :-)

Application Owner:	Kunal Deo
Contact Email:	kunaldeo2001@yahoo.com
Terms of Use:	☑ I have read and agree to the Yahoo! Developer Network Terms of Use.

Get API Key | Cancel

Above Generating the Yahoo App ID

```
starting with '>>>' indicate input
>>> execfile("LUDYSearch.py")
>>> results = search('Linux User and
Developer')
>>> results['totalResultsAvailable']
123000000
>>> results['totalResultsReturned']
20
>>> items = results['Result']
>>> for Result in items:
...     print Result['Title'],Result['Url']
...
```

Linux User http://www.linuxuser.co.uk/
Linux User and Developer - Wikipedia, the free encyclopedia http://en.wikipedia.org/wiki/Linux_User_and_Developer
Linux User &amp; Developer | Linux User http://www.linuxuser.co.uk/tag/linux-user-developer/

Gathering system information

An important job for a system administrator is gathering system information. Here we will use the SIGAR (System Information Gatherer And Reporter) API to demonstrate how we can gather system information using Python. SIGAR is a very complete API and can provide lots of information, including:

1. System memory, swap, CPU, load average, uptime, logins.

2. Per-process memory, CPU, credential info, state, arguments, environment, open files.
3. File system detection and metrics.
4. Network interface detection, configuration info and metrics.
5. TCP and UDP connection tables.
6. Network route table.

Installing SIGAR

The first step is to build and install SIGAR. SIGAR is hosted at GitHub, so make sure that you have Git installed in your system. Then perform the following steps to install SIGAR and its Python bindings:

```
$ git clone git://github.com/hyperic/sigar.git sigar.git
$ cd sigar.git/bindings/python
$ sudo python setup.py install
```

At the end you should see a output similar to the following :
Writing /usr/local/lib/python2.6/dist-packages/pysigar-0.1.egg-info
SIGAR is a very easy-to-use library and can be used to get information on almost every aspect of a system. The next example shows you how to do this. The following code shows the memory and the file system information.

```
@code: PySysInfo.py
import os
import sigar
sg = sigar.open()
mem = sg.mem()
swap = sg.swap()
fslist = sg.file_system_list()
print “==========Memory Information==============”
print “\tTotal\tUsed\tFree”
print “Mem:\t”,\
    (mem.total() / 1024), \
    (mem.used() / 1024), \
    (mem.free() / 1024)
print “Swap:\t”, \
    (swap.total() / 1024), \
    (swap.used() / 1024), \
    (swap.free() / 1024)
print “RAM:\t”, mem.ram(), “MB”
print “==========File System Information=============”
def format_size(size):
    return sigar.format_size(size * 1024)
print ‘Filesystem\tSize\tUsed\tAvail\tUse%\tMounted on\tType\n’
for fs in fslist:
    dir_name = fs.dir_name()
    usage = sg.file_system_usage(dir_name)
    total = usage.total()
    used = total - usage.free()
    avail = usage.avail()
    pct = usage.use_percent() * 100
    if pct == 0.0:
        pct = ‘-’
    print fs.dev_name(), format_size(total), format_size(used), format_size(avail),\
        pct, dir_name, fs.sys_type_name(), ‘/’, fs.type_name()
@Output
==========Memory Information==============
        Total   Used    Free
Mem:    8388608 6061884 2326724
Swap:   131072  16048   115024
RAM:    8192 MB
==========File System Information============
Filesystem      Size    Used    Avail   Use%    Mounted on      Type
```

```
/dev/disk0s2 300G 175G 124G 59.0 / hfs / local
devfs 191K 191K    0   - /dev devfs / none
```

Accessing Secure Shell (SSH) services

SSH (Secure Shell) is a modern replacement for an old remote shell system called Telnet. It allows data to be exchanged using a secure channel between two networked devices. System administrators frequently use SSH to administrate networked systems. In addition to providing remote shell, SSH is also used for secure file transfer (using SSH File Transfer Protocol, or SFTP) and remote X server forwarding (allows you to use SSH clients as X server). In this section we will learn how to use the SSH protocol from Python using a Python module called paramiko, which implements the SSH2 protocol for Python.
paramiko can be installed using the following steps:

```
$ git clone https://github.com/robey/paramiko.git
$ cd paramiko
$ sudo python setup.py install
```

To the core of paramiko is the SSHClient class. This class wraps L{Transport}, L{Channel}, and L{SFTPClient} to handle most of the aspects of SSH. You can use SSHClient as:

```
client = SSHClient()
client.load_system_host_keys()
client.connect(‘some.host.com’)
stdin, stdout, stderr = client.exec_command(‘dir’)
```

The following example demonstrates a full SSH client written using the paramiko module.

```
@code: PySSHClient.py
import base64, getpass, os, socket, sys, socket, traceback
import paramiko
import interactive
# setup logging
paramiko.util.log_to_file(‘demo_simple.log’)
# get hostname
username = ‘’
if len(sys.argv) > 1:
    hostname = sys.argv[1]
    if hostname.find(‘@’) >= 0:
        username, hostname = hostname.split(‘@’)
else:
    hostname = raw_input(‘Hostname: ’)
if len(hostname) == 0:
    print ‘*** Hostname required.’
    sys.exit(1)
port = 22
if hostname.find(‘:’) >= 0:
    hostname, portstr = hostname.split(‘:’)
    port = int(portstr)
# get username
if username == ‘’:
    default_username = getpass.getuser()
    username = raw_input(‘Username [%s]: ‘ % default_username)
    if len(username) == 0:
        username = default_username
password = getpass.getpass(‘Password for %s@%s: ‘ % (username, hostname))
# now, connect and use paramiko Client to negotiate SSH2 across the connection
try:
    client = paramiko.SSHClient()
    client.load_system_host_keys()
    client.set_missing_host_key_policy(paramiko.WarningPolicy)
    print '*** Connecting...'
    client.connect(hostname, port, username, password)
    chan = client.invoke_shell()
    print repr(client.get_transport())
    print '*** SSH Server Connected! ***'
    print
    interactive.interactive_shell(chan)
    chan.close()
    client.close()
except Exception, e:
    print '*** Caught exception: %s: %s' % (e.__class__, e)
    traceback.print_exc()
    try:
        client.close()
    except:
        pass
    sys.exit(1)
```

To run this code you will also need a custom Python class interactive.py which implements the interactive shell for the SSH session. Look for this file on FileSilo and copy it into the same folder where you have created PySSHClient.py .

```
@code_Output
kunal@ubuntu-vm-kdeo:~/src/paramiko/demos$ python demo_simple.py
Hostname: 192.168.1.2
Username [kunal]: luduser
Password for luduser@192.168.1.2:
*** Connecting...
<paramiko.Transport at 0xb76201acL (cipher aes128-ctr, 128 bits) (active; 1 open channel(s))>
*** SSH Server Connected! ***
Last login: Thu Jan 13 02:01:06 2011 from 192.168.1.9
[~ $:]
```

If the host key for the SSH server is not added to your $HOME/.ssh/known_hosts file, the client will throw the following error:

```
*** Caught exception: <type 'exceptions.TypeError'>: unbound method missing_host_key() must be called with WarningPolicy instance as first argument (got SSHClient instance instead)
```

This means that the client cannot verify the authenticity of the server you are connected to. To add the host key to known_hosts, you can use the ssh command. It is important to remember that this is not the ideal way to add the host key; instead you should use ssh-keygen. But for simplicity's sake we are using the ssh client.

```
kunal@ubuntu-vm-kdeo:~/.ssh$ ssh luduser@192.168.1.2
The authenticity of host '192.168.1.2 (192.168.1.2)' can't be established.
RSA key fingerprint is be:01:76:6a:b9:bb:69:64:e3:dc:37:00:a4:36:33:d1.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '192.168.1.2' (RSA) to the list of known hosts.
```

So now you've seen just how easy it can be to carry out the complex sysadmin tasks using Python's versatile language.

As is the case with all Python coding, the code that is presented here can fairly easily be adopted into your GUI application (using software such as PyGTK or PyQt) or a web application (using a framework such as Django or Grok).

Writing a user interface using Python

Administrators are comfortable with running raw scripts by hand, but end-users are not. So if you are writing a script that is supposed to be used by common users, it is a good idea to create a user-friendly interface on top of the script. This way end-users can run the scripts just like any other application. To demonstrate this, we will create a simple GRUB configuration tool which allows users to select default boot entry and the timeout. We will be creating a TUI (text user interface) application and will use the Python module 'snack' to facilitate this (not to be confused with the Python audio library, tksnack).

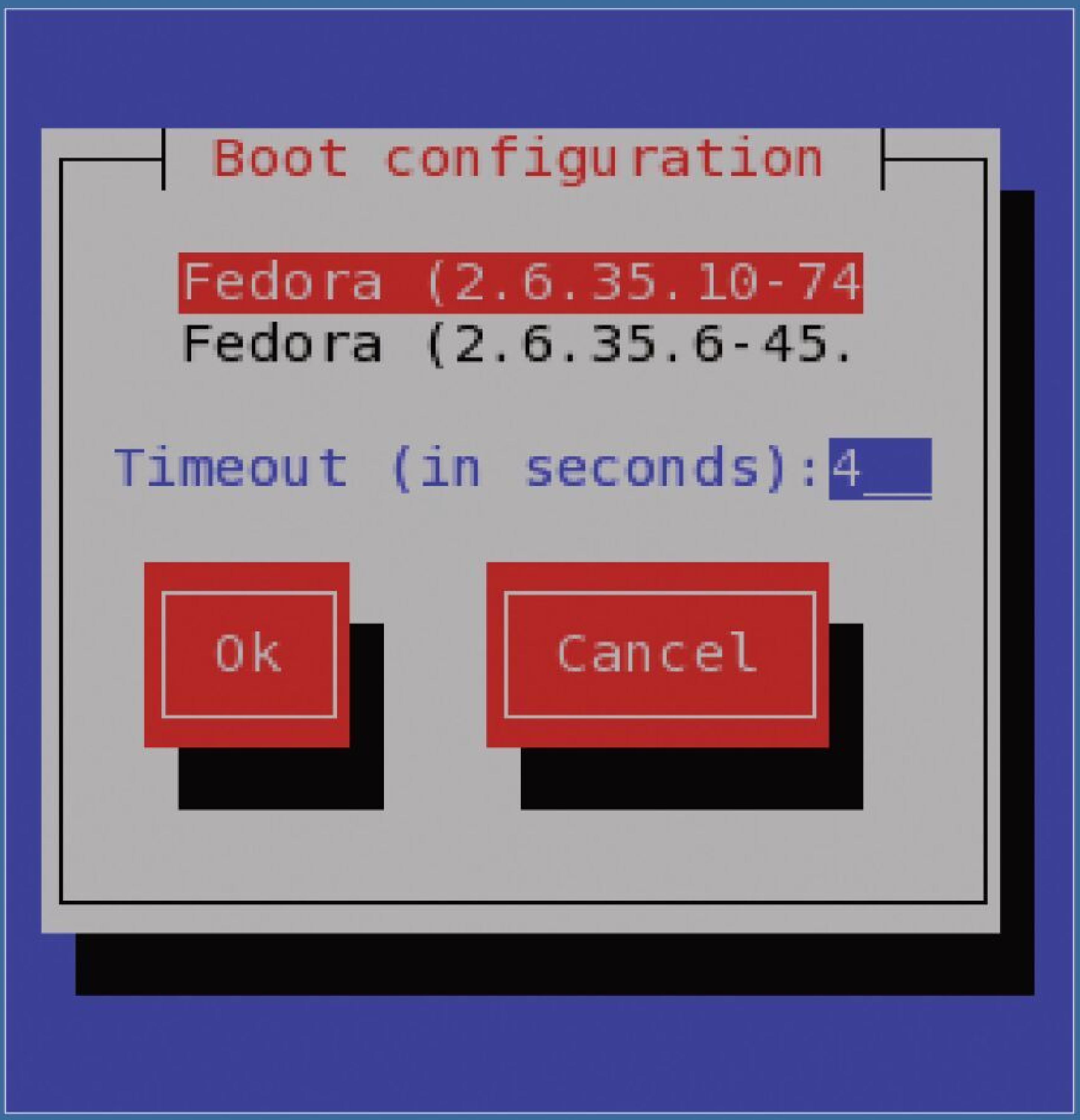
This app consists of two files…

grub.py: GRUB Config File (grub.conf) Parser (available on FileSilo). It implements two main functions, readBootDB() and writeBootFile(), which are responsible for reading and writing the GRUB configuration file.
grub_tui.py: Text user interface file for manipulating the GRUB configuration file using the functions available in grub.py.

```
@code:grub_tui.py
import sys
from snack import *

from grub import (readBootDB, writeBootFile)

def main(entry_value=’1’,kernels=[]):
    try:
        (default_value, entry_value,
kernels)=readBootDB()
    except:
        print >> sys.stderr, (“Error reading /boot/
grub/grub.conf.”)
sys.exit(10)

    screen=SnackScreen()

    while True:
        g=GridForm(screen, (“Boot configuration”),1,5)
        if len(kernels)>0 :
            li=Listbox(height=len(kernels), width=20,
returnExit=1)
            for i, x in enumerate(kernels):
                li.append(x,i)
            g.add(li, 0, 0)
            li.setCurrent(default_value)

        bb = ButtonBar(screen, (((“Ok”), “ok”),
((“Cancel”), “cancel”)))

        e=Entry(3, str(entry_value))
        l=Label((“Timeout (in seconds):”))
        gg=Grid(2,1)
        gg.setField(l,0,0)
        gg.setField(e,1,0)

        g.add(Label(‘’),0,1)
        g.add(gg,0,2)
        g.add(Label(‘’),0,3)
        g.add(bb,0,4,growx=1)
        result = g.runOnce()
        if bb.buttonPressed(result) == ‘cancel’:
            screen.finish()
            sys.exit(0)
        else:
            entry_value = e.value()
            try :
                c = int(entry_value)
                break
            except ValueError:
                continue

    writeBootFile(c, li.current())
    screen.finish()

if __name__== ‘__main__’:
    main()
```

Start the tool using the sudo command (as it reads the grub.conf file)

```
$ sudo grub_tui.py
```



Fedora (2.6.35.10-74
Fedora (2.6.35.6-45.

Timeout (in seconds): 4

What you'll need…

Beautiful Soup
www.crummy.com/software/BeautifulSoup/

HTML5Lib
https://github.com/html5lib/html5lib-python

Python 2.6+ & WikiParser.zip Six
https://pypi.python.org/pypi/six/

Scrape Wikipedia with Beautiful Soup

Use the Beautiful Soup Python library to parse Wikipedia's HTML and store it for offline reading

In this tutorial we'll use the popular Python library Beautiful Soup to scrape Wikipedia for links to articles and then save those pages for offline reading. This is ideal for when travelling or in a location with a poor internet connection.

The plan is simple: using Beautiful Soup with the HTML5Lib Parser, we're going to load a Wikipedia page, remove all of the GUI and unrelated content, search the content for links to other Wikipedia articles and then, after a tiny bit of modification, write them to a file.

Even though it's now the de facto knowledge base of the world, Wikipedia isn't great when it comes to DOM consistency – that is, IDs and classes are sometimes quite loose in their usage. Because of this, we will also cover how to handle all of the excess bits and bobs of the Wikipedia GUI that we don't need, as well as the various erroneous links that won't be of much use to us. You can find the CSS stylings sheet and a Python script pertaining to this tutorial at **http://bit.ly/19MibBv**.

Install Beautiful Soup & HTML5Lib

01 Before we can start writing code, we need to install the libraries we'll be using for the program (Beautiful Soup, HTML5Lib, Six). The installation process is fairly standard: grab the libraries from their respective links, then unzip them. In the terminal, enter the unzipped directory and run python setup.py install for each library. They will now be ready for use.

> "Wikipedia isn't great when it comes to DOM consistency"

Infinite Links

Wikipedia has a lot of links and when you start following links to links to links, the number of pages you have to parse can grow exponentially, depending on the subject matter. By passing through the levels value, we put a cap on the amount of pages we can grab–- although the number of files stored can still vary greatly. Use it wisely.

Full code listing

1 Import libraries
These are the libraries we are going to be using for this program

01

```
import os, sys, urllib2, argparse, datetime, atexit
from bs4 import BeautifulSoup
```

2 Set up variables
These are some variables we'll use to keep track of the script's progress

02

```
addresses = []
deepestAddresses = []

maxLevel = 1
storeFolder = "Wikistore " + str(datetime.datetime.now().strftime("%Y-%m-%d %H:%M"))

undesirables = [ {"element" : "table", "attr" : {'class' : 'infobox'} }, {"element" :
"table", "attr" : {'class' : 'vertical-navbox'}}, {"element" : "span", "attr" : {'class'
: 'mw-editsection'}}, {"element" : "div", "attr" : {'class' : 'thumb'}}, {"element"
: "sup", "attr" : {'class' : 'reference'}}, {"element" : "div", "attr" : {'class' :
'reflist'}}, {"element" : "table", "attr" : {'class' : 'nowraplinks'}}, {"element" :
"table", "attr" : {'class' : 'ambox-Refimprove'}}, {"element" : "img", "attr" : None},
{"element" : "script", "attr" : None}, {"element" : "table", "attr" : {'class' :
'mbox-small'}} , {"element" : "span", "attr" : {"id" : "coordinates"}}, {"element" :
"table", "attr" : {"class" : "ambox-Orphan"}}, {"element" : "div", "attr" : {"class" :
"mainarticle"}}, {"element" : None, "attr" : {"id" : "References"}} ]
```

3 Initialisation
This is the initialising function that we will use to handle the input coming from the user

03

```
def init():
    parser = argparse.ArgumentParser(description='Handle the starting page and number
of levels we\'re going to scrape')
    parser.add_argument('-URL', dest='link', action='store', help='The Wikipedia page
from which we will start scraping')
    parser.add_argument('-levels', dest="levels", action='store', help='How many levels
deep should the scraping go')
    args = parser.parse_args()

    if(args.levels != None):
        global maxLevel8
        maxLevel = int(args.levels)

    if(args.link == None):
        print("You need to pass a link with the -URL flag")
        sys.exit(0)
    else:
        if not os.path.exists(storeFolder):
            os.makedirs(storeFolder)

        grabPage(args.link, 0, args.link.split("/wiki/")[1].strip().replace("_", " "))

    atexit.register(cleanUp)

def isValidLink(link):

    if "/wiki/" in link and ":" not in link and "http://" not in link and "wikibooks"
not in link and "#" not in link and "wikiquote" not in link and "wiktionary" not in
link and "wikiversity" not in link and "wikivoyage" not in link and "wikisource" not
in link and "wikinews" not in link and "wikiversity" not in link and "wikidata" not
in link:
        return True
    else:
        return False
```

04

```
def grabPage(URL, level, name):

    opener = urllib2.build_opener()
    opener.addheaders = [('User-agent', 'Mozilla/5.0')]
    req = opener.open(URL)
```

Wiki-Everything

Wikipedia has so many different services that interlink with each other; however, we don't want to grab those pages, so we've got quite a lengthy conditional statement to stop that. It's pretty good at making sure we only get links from Wikipedia.

Creating some useful variables

02 These variables will keep track of the links we've accessed while the script has been running: addresses is a list containing every link we've accessed; deepestAddresses are the links of the pages that were the furthest down the link tree from our starting point; storeFolder is where we will save the HTML files we create and maxLevel is the maximum depth that we can follow the links to from our starting page.

Handling the user's input

03 In the first few lines of this function, we're just creating a helper statement. Afterwards, we're parsing any arguments passed into the program on its execution and looking for a -URL flag and a -levels flag. The -levels flag is optional as we already have a preset depth that we'll follow the links to, but we need a link to start from so if the -URL flag is missing, we'll prompt the user and exit. If we have a link, then we quickly check whether or not we have a directory to store files in – which we'll create if we don't – and then we'll fire off the function to get that page. Finally, we register a handler for when the script tries to exit. We'll get to that bit later.

Retrieving the page from the URL

04 Here we're using URLLib2 to request the page the the user has asked for and then, once we've received that page, we're going to pass the content through to Beautiful Soup with the soup variable. This gives us access to the methods we're going to call as we parse the document.

Trimming the fat

05 Wikipedia has a lot of nodes that we don't want to parse. The content variable allows us to straight away ignore most of Wikipedia's GUI, but there are still lots of elements that we don't want to parse. We remedy this by iterating through the list 'undesirables' that we created earlier on in the document. For each different div/section/node that we don't want, we call Beautiful Soup's find_all() method and use the extract() method to remove that node from the document. At the end of the undesirables loop, most of the content we don't want any more will be gone. We also look for the 'also' element in the Wiki page. Generally, everything after this div is of no use to us. By calling the find_all_next() method on the also node, we can get a list of every other element we can remove from that point on.

> "The HTML page uses built-in browser styles when rendering the page"

> “Wikipedia has so many different services that interlink with each other; we don’t want to grab those pages”

4 Get the page
Here we grab the page we want to store and remove the bits of the document we don’t need

04

```
    page = req.read()

    req.close()

    soup = BeautifulSoup(page, “html5lib”, from_encoding=”UTF-8”)

    content = soup.find(id=”mw-content-text”)

    if hasattr(content, ‘find_all’):

        global undesirables

        for notWanted in undesirables:

            removal = content.find_all(notWanted[‘element’], notWanted[‘attr’])
            if len(removal) > 0:
                for el in removal:
                    el.extract()

        also = content.find(id=”See_also”)

        if(also != None):
            also.extract()
            tail = also.find_all_next()
            if(len(tail) > 0):
                for element in tail:
                    element.extract()
```

5 Check links
Then we iterate through all of the <a> tags and check if there’s a valid link to another page we can grab, and tweak them for our own use

05

```
        for link in content.find_all(‘a’):

            href = link[“href”]

            if isValidLink(href):

                if level < maxLevel:

                    stored = False;
                    for addr in addresses:
                        if addr == link.get(“href”):
                            stored = True

                    if(stored == False):
                        title = link.get(‘href’).replace(“/wiki/”, “”)
                        addresses.append(str(title + “.html”))
                        grabPage(“http://en.wikipedia.org” + link.get(‘href’), level +
1, title)
                    print title

            link[“href”] = link[“href”].replace(“/wiki/”, “”) + “.html”
```

06

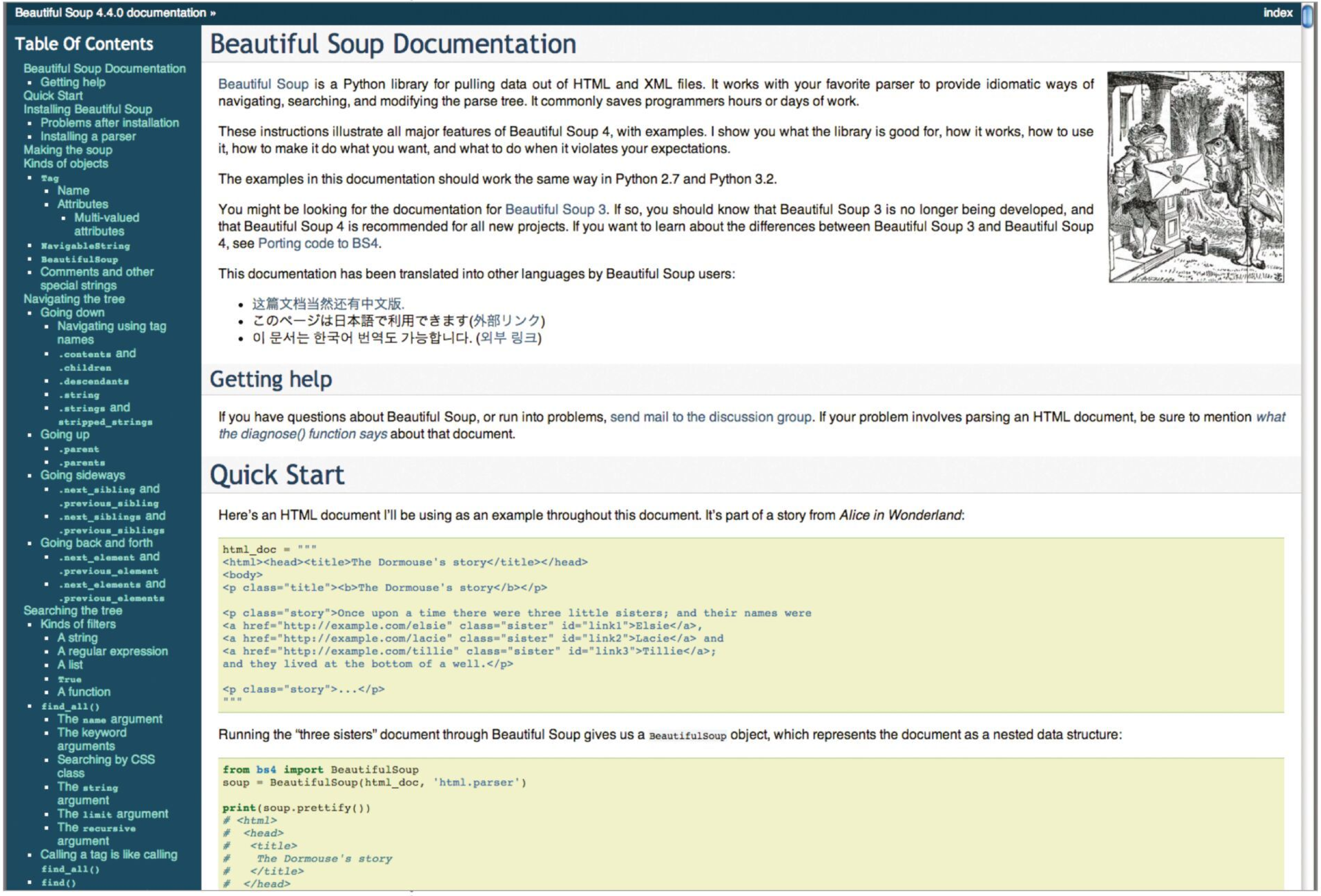
```
        fileName = str(name)

        if level == maxLevel:
            deepestAddresses.append(fileName.replace(‘/’, ‘_’) + “.html”)
```

Styling

Currently, the HTML page will use the built-in browser styles when rendering the page. If you like, you can include the style sheet included in the tutorial resources to make it look a little nicer. To use it, you can minify the script and include it inside a <style> tag in the head string on line 102, or you can rewrite the head string to something like:

```
head = “<head><meta
charset=\”UTF-8\” /><title>” +
fileName + “</title><style>” +
str(open(“/PATH/TO/STYLES”, ‘r’).
read()) + “</style></head>”
```

Scrape Wikipedia with Beautiful Soup



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Beautiful Soup Documentation

Beautiful Soup is a Python library for pulling data out of HTML and XML files. It works with your favorite parser to provide idiomatic ways of navigating, searching, and modifying the parse tree. It commonly saves programmers hours or days of work.

These instructions illustrate all major features of Beautiful Soup 4, with examples. I show you what the library is good for, how it works, how to use it, how to make it do what you want, and what to do when it violates your expectations.

The examples in this documentation should work the same way in Python 2.7 and Python 3.2.

You might be looking for the documentation for Beautiful Soup 3. If so, you should know that Beautiful Soup 3 is no longer being developed, and that Beautiful Soup 4 is recommended for all new projects. If you want to learn about the differences between Beautiful Soup 3 and Beautiful Soup 4, see Porting code to BS4.

This documentation has been translated into other languages by Beautiful Soup users:

- 这篇文档当然还有中文版.
- このページは日本語で利用できます(外部リンク)
- 이 문서는 한국어 번역도 가능합니다. (외부 링크)

Getting help

If you have questions about Beautiful Soup, or run into problems, send mail to the discussion group. If your problem involves parsing an HTML document, be sure to mention *what the diagnose() function says* about that document.

Quick Start

Here's an HTML document I'll be using as an example throughout this document. It's part of a story from *Alice in Wonderland*:

```
html_doc = """
<html><head><title>The Dormouse's story</title></head>
<body>
<p class="title"><b>The Dormouse's story</b></p>

<p class="story">Once upon a time there were three little sisters; and their names were
<a href="http://example.com/elsie" class="sister" id="link1">Elsie</a>,
<a href="http://example.com/lacie" class="sister" id="link2">Lacie</a> and
<a href="http://example.com/tillie" class="sister" id="link3">Tillie</a>;
and they lived at the bottom of a well.</p>

<p class="story">...</p>
"""
```

Running the "three sisters" document through Beautiful Soup gives us a `BeautifulSoup` object, which represents the document as a nested data structure:

```
from bs4 import BeautifulSoup
soup = BeautifulSoup(html_doc, 'html.parser')

print(soup.prettify())
# <html>
#  <head>
#   <title>
#    The Dormouse's story
#   </title>
#  </head>
```

Above Find the documentation for Beautiful Soup at http://bit.ly/O2H8iD

Grabbing the links

06 By calling content.find_all('a') we get a list of every <a> in the document. We can iterate through this and check whether or not there is a valid Wikipedia link in the <a>'s href. If the link is a valid link, we quickly check how far down the link tree we are from the original page. If we've reached the maximum depth we can go, we'll store this page and call it quits, otherwise we'll start looking for links that we can grab within it. For every page we request, we append its URL to the addresses list; to make sure we don't call the same page twice for each link we find, we check if we've already stored it. If we have, then we'll skip over the rest of the loop, but if we've not then we'll add it to the list of URLs that we've requested and fire off a request. Once that check is done, We then do a quick string replace on that link so that it points to the local directory, not to the subfolder /wiki/ that it's looking for.

Writing to file

07 Now we create a file to store the newly parsed document in for later reading. We change any '/' in the filename to '_' so the script doesn't try and write to a random folder. We also do a quick check to see how many links we've followed since the first page. If it's the max level, we'll add it to the deepestAddresses list. We'll use this a little bit later.

Tying up loose ends

08 After our script has iterated through every link on every page to the maximum level of depth that it can, it will try to exit. On line 34 of the code (on the disc and online) in the init function, we registered the function cleanUp to execute on the program trying to exit; cleanUp's job is to go through the documents that we've downloaded and check that every link we've left in the pages does in fact link to a file that we have available. If it can't match the link in the href to a file in the addresses list, it will remove it. Once we're done, we will have a fully portable chunk of Wikipedia we can take with us.

6 Copy to file
After that, We take the content we've parsed and put it into a brand new HTML file

06

```
        doctype = “<!DOCTYPE html>”

        head = “<head><meta charset=\”UTF-8\” /><title>” + fileName + “</title></
head>”

        f = open(storeFolder + “/” + fileName.replace(‘/’, ‘_’) + “.html”, ‘w’)
        f.write(doctype + “<html lang=\”en\”>” + head + “<body><h1>” + fileName + “</
h1>” + str(content) + “</body></html>”)
        f.close()
```

7 Clean up
Once every page has been parsed and stored, we'll go on through and try to remove any dead links

07

```
def cleanUp():

    print(“\nRemoving links to pages that have not been saved\n”)

    for deepPage in deepestAddresses:

        rF = open(storeFolder + “/” + deepPage, ‘r’)

        deepSoup = BeautifulSoup(rF.read(),  “html5lib”, from_encoding=”UTF-8”)

        for deepLinks in deepSoup.find_all(‘a’):
            link = deepLinks.get(“href”)

            pageStored = False

            for addr in addresses:
                if addr == link:
                    pageStored = True

            if pageStored == False:

                if link is not None:

                    if ‘#’ not in link:
                        del deepLinks[‘href’]
                    elif ‘#’ in link and len(link.split(‘#’)) > 1 or ‘:’ in link:
                        del deepLinks[‘href’]

        wF = open(storeFolder + “/” + deepPage, ‘w’)
        wF.write(str(deepSoup))
        wF.close()

    print(“Complete”)
```

8 Initialise
This is how we will initialise our script

08

```
if __name__ == “__main__”:
    init()
```

Create with Python

Use Python to get creative and program games

What could be more satisfying than playing a game that you have programmed yourself? In this section we're going to show you how to do just that. We'll get started with a simple game of tic-tac-toe, made with the help of Kivy (p.80), before stepping things up a notch and cloning the classic favourite, Pong (p.86). Then, it's time to have a go at making a Space Invaders-inspired game complete with retro graphics (p.88). Coding games is one of the best ways to learn more Python, plus you have something to play afterwards!

SCORE 0
Pivaders - Press ESC to quit
LIVES 3
hp
ProBook
BoConcept

"Making a playable game is not as difficult as you may think"

What you'll need…

Python
www.python.org/doc

Build tic-tac-toe with Kivy

Ease into the workings of Kivy by creating the pen-and-paper classic in just over 100 lines of Python...

Kivy is a highly cross-platform graphical framework for Python, designed for the creation of innovative user interfaces like multitouch apps. Its applications can run not only on the traditional desktop platforms of Linux, OS X and Windows, but also Android and iOS, plus devices like the Raspberry Pi.

That means you can develop cross-platform apps using Python libraries such as Requests, SQLAlchemy or even NumPy. You can even access native mobile APIs straight from Python using some of Kivy's sister projects. Another great feature is the Cython-optimised OpenGL graphics pipeline, allowing advanced GPU effects even though the basic Python API is very simple.

Kivy is a set of Python/Cython modules that can easily be installed via pip, but you'll need a few dependencies. It uses Pygame as a rendering backend (though its API is not exposed), Cython for compilation of the speedy graphics compiler internals, and GStreamer for multimedia. These should all be available through your distro's repositories, or via pip where applicable.

With these dependencies satisfied, you should be able install Kivy with the normal pip incantation. The current version is 1.8.0, and the same codebase supports both python2 and python3. The code in this tutorial is also version-agnostic, running in python2.7 and python3.3.

```
pip install kivy
```

If you have any problems with pip, you can use easy_install via easy_install kivy.

There are also packages or repositories available for several popular distros. You can find more information on Kivy's website. A kivy application is started by instantiating and running an 'App' class. This is what initialises our pp's window, interfaces with the OS, and provides an entry point for the creation of our GUI. We can start by making the simplest Kivy app possible:

```
from kivy.app import App

class TicTacToeApp(App):
  pass

if __name__ == “__main__”:
  TicTacToeApp().run()
```

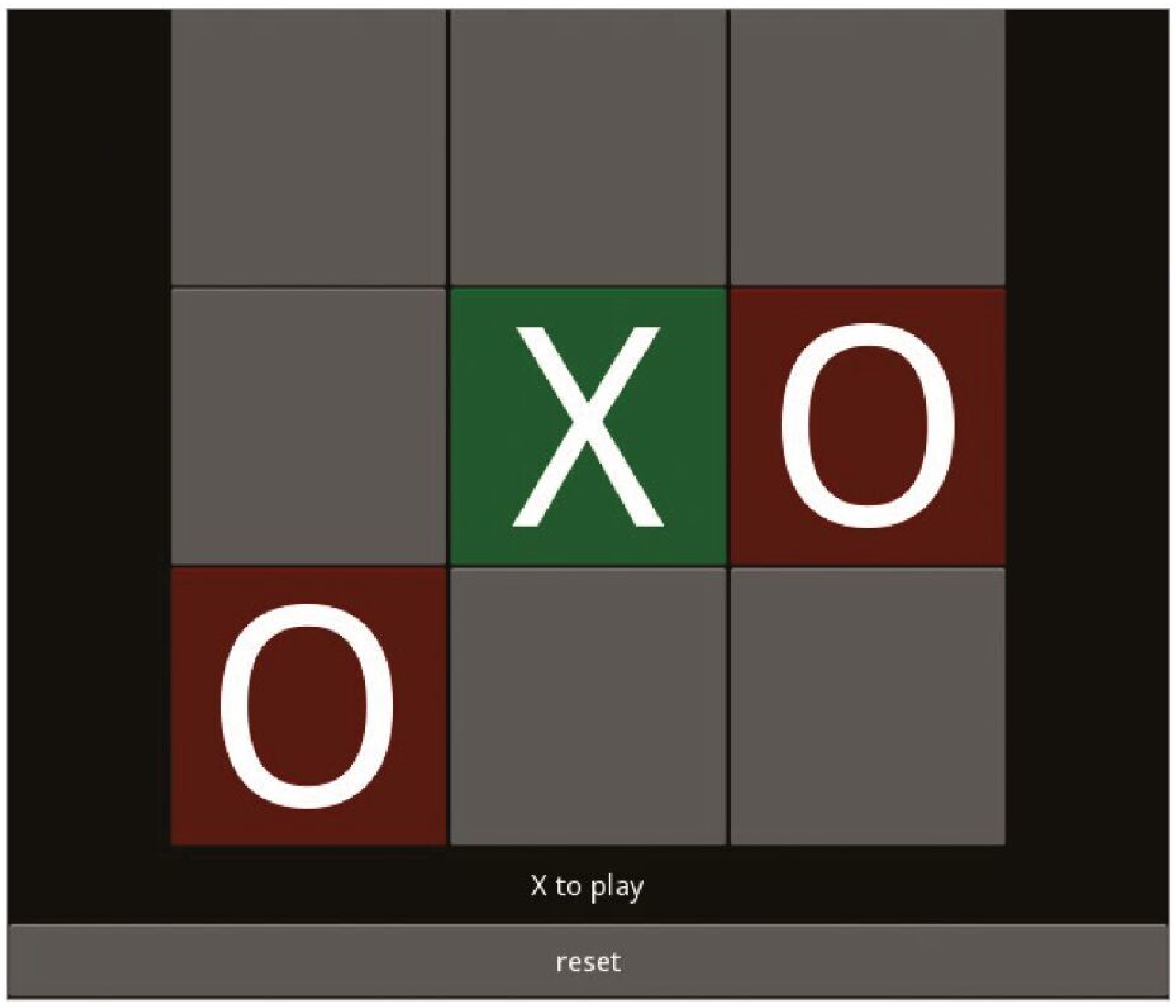
You can already run this, your app will start up and you'll get a plain black window. Exciting!

We can build our own GUI out of Kivy widgets. Each is a simple graphics element with some specific behaviour of its own ranging from standard GUI functionality (eg the Button, Label or TextInput), to those that impose positioning on their child widgets (eg the BoxLayout, FloatLayout or GridLayout), to those abstracting a more involved task like interacting with hardware (eg the FileChooser, Camera or VideoPlayer). Most importantly, Kivy's widgets are designed to be easily combined - rather than including a widget for every need imaginable, widgets are kept simple but are easy to join to invent new interfaces. We'll see some of that in this tutorial.

Since 'Hello World!' is basically compulsory in any programming tutorial, let's get it over with by using a simple 'Label' widget to display the text:

```
from kivy.uix.label import Label
```

We'll display the 'Label' by returning it as our app's root widget. Every app has a single root widget, the top level of its widget tree, and it will automatically be sized to fill the window. We'll see later how to construct a full GUI by adding more widgets for this one, but for now it's enough to set the root widget by adding a new method to the 'App':



Above The game with final additions, making the grid square and extending the interface

```
def build(self):
  return Label(text='Hello World!',
  font_size=100,
  color=0, 1, 0, 1))  # (r, g, b, a)
```

The 'build' method is called when the 'App' is run, and whatever widget is returned automatically becomes the root widget of that App'. In our case that's a Label, and we've set several properties - the 'text', 'font_size' and 'color'. All widgets have different properties controlling aspects of their behaviour, which can be dynamically updated to alter their appearance later, though here we set them just once upon instantiation.

Note that these properties are not just Python attributes but instead Kivy properties. These are accessed like normal attributes but provide extra functionality by hooking into Kivy's event system. We'll see examples of creating properties shortly, and you should do the same if you want to use your variables with Kivy's event or binding functionality.

That's all you need to show some simple text, so run the program again to check that this does work. You can experiment with the parameters if it's unclear what any of them are doing.

Our own widget: tic-tac-toe

Since Kivy doesn't have a tic-tac-toe widget, we'll have to make our own! It's natural to create a new widget class to contain this behaviour:

```
from kivy.uix.gridlayout import GridLayout
class TicTacToeGrid(GridLayout):
  pass
```

Now this obviously doesn't do anything yet, except that it inherits all the behaviour of the Kivy GridLayout widget - that is, we'll need to tell it how many columns to have, but then it will automatically arrange any child widgets to fit nicely with as many rows as necessary. Tic-tac-toe requires three columns and nine children.

Here we introduce the Kivy language (kv), a special domain-specific language for making rules describing Kivy widget trees. It's very simple but removes a lot of necessary boilerplate for manipulating the GUI with Python code - as a loose analogy you might think of it as the HTML/CSS to Python's JavaScript. Python gives us the dynamic power to do anything, but all that power gets in the way if we just want to declare the basic structure of our GUI. Note that you never need kv language, you can always do the same thing in Python alone, but the rest of the example may show why Kivy programmers usually like to use kv.

Kivy comes with all the tools needed to use kv language; the simplest way is to write it in a file with a name based on our App class. That is, we should place the following in a file named 'tictactoe.kv':

```
<TicTacToeGrid>:
  cols: 3
```

This is the basic syntax of kv language; for each widget type we may write a rule defining its behaviour, including setting its properties and adding child widgets. This example demonstrates the former, creating a rule for the 'TicTacToeGrid' widget by declaring that every 'TicTacToeGrid' instantiated should have its 'cols' property set to 3.

We'll use some more kv language features later, but for now let's go back to Python to create the buttons that will be the entries in our tic-tac-toe grid.

```
from kivy.uix.button import Button
from kivy.properties import ListProperty

class GridEntry(Button):
  coords = ListProperty([0, 0])
```

This inherits from Kivy's 'Button' widget, which interacts with mouse or touch input, dispatching events when interactions toggle it. We can hook into these events to call our own functions when a user presses the button, and can set the button's 'text' property to display the 'X' or 'O'. We also created a new Kivy property for our widget, 'coords' – we'll show how this is useful later on. It's almost identical to making a normal Python attribute by writing 'self.coords = [0, 0]' in 'GridEntry.__init__'.

As with the 'TicTacToeGrid', we'll style our new class with kv language, but this time we get to see a more interesting feature.

```
<GridEntry>:
  font_size: self.height
```

As before, this syntax defines a rule for how a 'GridEntry' widget should be constructed, this time setting the 'font_size' property that controls the size of the text in the button's label. The extra magic is that kv language automatically detects that we've referenced the Button's own height and will create a binding to update this relationship – when a 'GridEntry' widget's height changes, its 'font_size' will change so the text fits perfectly. We could have made these bindings straight from Python (another usage of the 'bind' method used later on), but that's rarely as convenient as referencing the property we want to bind to.

Let's now populate our 'TicTacToeGrid' with 'GridEntry' widgets.

```
class TicTacToeGrid(GridLayout):
  def __init__(self, *args, **kwargs):
  super(TicTacToeGrid, self).__init__(*args,
**kwargs)
  for row in range(3):
    for column in range(3):
    grid_entry = GridEntry(
      coords=(row, column))
    grid_entry.bind(on_release=self.button_
pressed)
    self.add_widget(grid_entry)

  def button_pressed(self, instance):
  print('{} button clicked!'.format(instance.
coords))
```

This introduces a few new concepts: When we instantiated our 'GridEntry' widgets, we were able to set their 'coords' property by simply passing it in as a kwarg. This is a minor feature that is automatically handled by Kivy properties.

We used the 'bind' method to call the grid's 'button_pressed' method whenever the `GridEntry` widget dispatches an 'on_release' event. This is automatically handled by its 'Button' superclass, and will occur whenever a user presses, then releases a 'GridEntry' button. We could also bind to 'on_press', which is dispatched when the button is first clicked, or to any Kivy property of the button, dispatched dynamically when the property is modified.

We added each 'GridEntry' widget to our 'Grid' via the 'add_widget' method. That means each one is a child widget of the 'TicTacToeGrid', and so it will display them and knows it should automatically arrange them into a grid with the number of columns we set earlier.

Now all we have to do is replace our root widget (returned from 'App.build') with a 'TicTacToeGrid' and we can see what our app looks like.

```
def build(self):
  return TicTacToeGrid()
```

With this complete you can run your main Python file again and enjoy your new program. All being well, the single Label is replaced by a grid of nine buttons, each of which you can click (it will automatically change colour) and release (you'll see the printed output information from our binding).

We could customise the appearance by modifying other properties of the Button, but for now we'll leave them as they are.

Has anyone won yet?

We'll want to keep track of the state of the board to check if anyone has won, which we can do with a couple more Kivy properties:

```
from kivy.properties import (ListProperty,
NumericProperty)

class TicTacToeGrid(GridLayout):
  status = ListProperty([0, 0, 0, 0, 0, 0,
                             0, 0, 0])
  current_player = NumericProperty(1)
```

This adds an internal status list representing who has played where, and a number to represent the current player (1 for 'O', -1 for 'X').

By placing these numbers in our status list, we'll know if somebody wins because the sum of a row, column or diagonal will be +-3. Now we can update our graphical grid when a move is played.

```
def button_pressed(self, button):
    player = {1: ‘O’, -1: ‘X’}
    colours = {1: (1, 0, 0, 1), -1: (0, 1, 0,
              1)}  # (r, g, b, a)

    row, column = button.coords

    status_index = 3*row + column
    already_played = self.status[status_index]

    if not already_played:
        self.status[status_index] = self.
                    current_player
        button.text = {1: ‘O’, -1: ‘X’}[self.
                    current_player]
        button.background_color = colours[self.
                    current_player]
        self.current_player *= -1
```

You can run your app again to see exactly what this did, and you'll find that clicking each button now places an 'O' or 'X' as well as a coloured background depending on whose turn it is to play. Not only that, but you can only play one move in each button thanks to our status array that keeps track of the existing moves.

This is enough to play the game but there's one vital element missing... a big pop-up telling you when you've won! Before we can do that, we need to add some code to check if the game is over.

Kivy properties have another useful feature here, whenever they change they automatically call an 'on_propertyname' method if it exists and dispatch a corresponding event in Kivy's event system. That makes it very easy to write code that will run when a property changes, both in Python and kv language. In our case we can use it to check the status list every time it is updated, doing something special if a player has filled a column, row or diagonal.

```
def on_status(self, instance, new_value):
    status = new_value

    sums = [sum(status[0:3]),  # rows
        sum(status[3:6]),
        sum(status[6:9]),
        sum(status[0::3]),  # columns
        sum(status[1::3]),
        sum(status[2::3]),
        sum(status[::4]),  # diagonals
        sum(status[2:-2:2])]

    if 3 in sums:
    print(‘Os win!’)
    elif -3 in sums:
    print(‘Xs win!’)
    elif 0 not in self.status:  # Grid full
    print(‘Draw!’)
```

This covers the basic detection of a won or drawn board, but it only prints the result to stdout. At this stage we probably want to reset the board so that the players can try again, along with displaying a graphical indicator of the result.

```
def reset(self, *args):
    self.status = [0 for _ in range(9)]

    for child in self.children:
        child.text = ‘’
        child.background_color = (1, 1, 1, 1)

    self.current_player = 1
```

Finally, we can modify the `on_status` method to both reset the board and display the winner in a 'ModalView' widget.

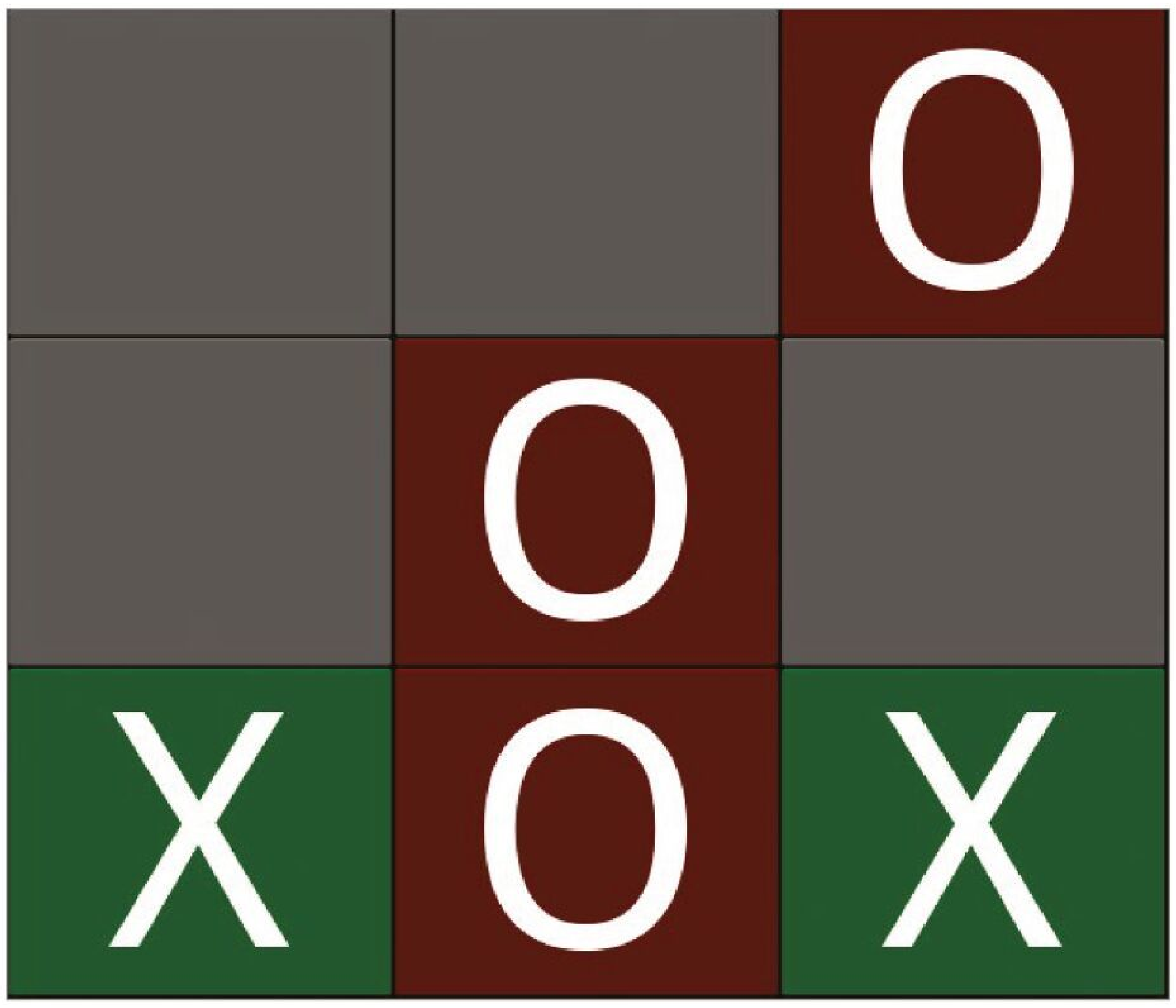
```
from kivy.uix.modalview import ModalView
```

This is a pop-up widget that draws itself on top of everything else rather than as part of the normal widget tree. It also automatically closes when the user clicks or taps outside it.

```
winner = None
if -3 in sums:
  winner = 'Xs win!'
elif 3 in sums:
  winner = 'Os win!'
elif 0 not in self.status:
  winner = 'Draw...nobody wins!'

if winner:
  popup = ModalView(size_hint=0.75, 0.5))
  victory_label = Label(text=winner,
  font_size=50)
  popup.add_widget(victory_label)
  popup.bind(on_dismiss=self.reset)
  popup.open()
```

This mostly uses the same ideas we already covered, adding the 'Label' widget to the 'ModalView' then letting the 'ModalView' take care of drawing itself and its children on top of everything else. We also use another binding; this time to 'on_dismiss', which is an event dispatched by the 'ModalView' when it is closed. Finally, we made use of the 'size_hint' property common to all widgets, which in this case is used to set the 'ModalView' size proportional to the window – while a 'ModalView' is open you can resize the window to see it dynamically resize, always maintaining these proportions. This is another trick made possible by a binding with the 'size_hint' Kivy property, this time managed internally by Kivy.

That's it, a finished program! We can now not only play tic-tac-toe, but our program automatically tells us when somebody has won, and resets the board so we can play again. Simply run your program and enjoy hours of fun!



Above A tic-tac-toe grid now accepting input, adding in an O or X alternately, each go

Time to experiment

This has been a quick tour through some of Kivy's features, but hopefully it demonstrates how to think about building a Kivy application. Our programs are built from individual Kivy widgets, interacting by having Python code run when their properties change (eg our 'on_status' method) or when they dispatch events (eg 'Button' 'on_release'). We also briefly saw kv language and experienced how it can automatically create bindings between properties.

You can find a copy of the full program on FileSilo, reference this to check you've followed everything correctly. We've also added an extra widget, the 'Interface', with a structure coded entirely in kv language that demonstrates how to add child widgets. Test it by uncommenting the 'return Interface()' line in 'TicTacToeGrid.build'. It doesn't do anything fundamentally different to what we already covered, but it does make extensive use of kv language's binding ability to automatically update a label showing the current player, and to resize the TicTacToeGrid so it is always square to fit within its parent. You can play with the settings to see how it fits together, or try swapping out the different widget types to see how other widgets behave.

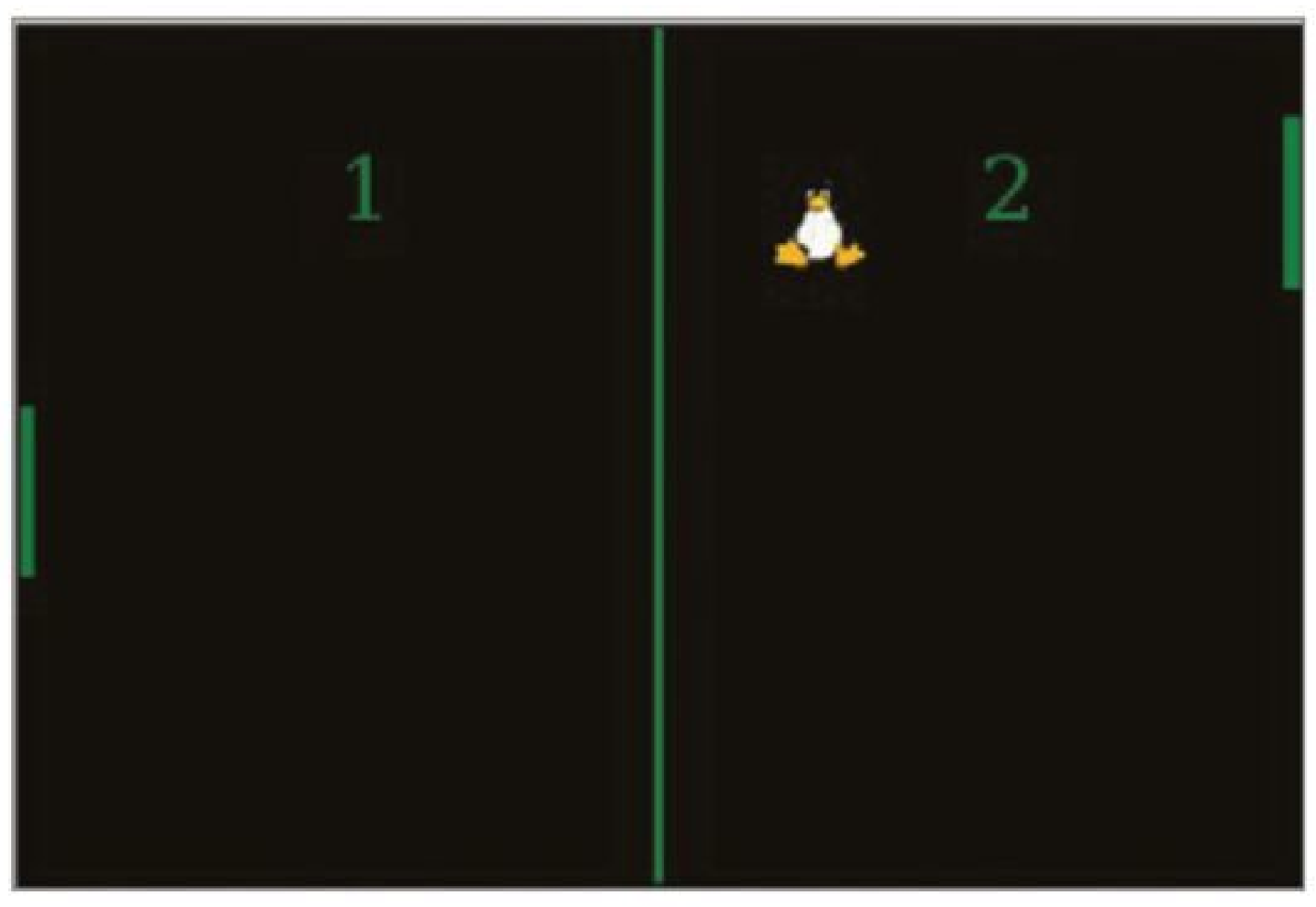
What you'll need…

Latest Raspbian Image
www.raspberrypi.org/downloads

Pillow
https://github.com/python-imaging/Pillow

SimpleGUITk
https://github.com/dholm/simpleguitk/

Below 'Tux for Two' is a great little Pong clone using the beloved Linux mascot, Tux, in the centre of the action



Make a Pong clone with Python

We update the retro classic Pong for the Linux generation with a new library called SimpleGUITk

The Raspberry Pi is a fantastic way to start learning how to code. One area that can be very rewarding for amateur coders is game programming, allowing for a more interactive result and a greater sense of accomplishment. Game programming can also teach improvisation and advanced mathematics skills for code. We'll be using the fantastic SimpleGUITk module in Python, a very straightforward way of creating graphical interfaces based on Tkinter.

Python module preparation

01 Head to the websites we've listed in 'What you'll need' and download a zip of the source files from the GitHub pages. Update your Raspbian packages and then install the following:

```
$ sudo apt-get install python-dev python-setuptools tk8.5-dev
tcl8.5-dev
```

Install the modules

02 Open the terminal and use cd to move to the extracted Pillow folder. Once there, type:

```
$ sudo python setup.py install
```

Once that's complete, move to the **simpleguitk** folder and use the same command to install that as well.

Write your code

03 Launch IDLE 2, rather than IDLE 3, and open a new window. Use the code listing to create our game 'Tux for Two'. Be careful to follow along with the code to make sure you know what you're doing. This way, you can make your own changes to the game rules if you wish.

Set up the game

04 There's nothing too groundbreaking to start the code: Tux's and the paddles' initial positions are set, along with the initial speed and direction of Tux. These are also used when a point is won and the playing field is reset. The direction and speed is set to random for each spawn.

The SimpleGUI code

05 The important parts in the **draw** function are the **draw_line**, **draw_image** and **draw_text** functions. These are specifically from SimpleGUI, and allow you to easily put these objects on the screen with a position, size and colour. You need to tie them to an object, though – in this case, **canvas**. This tells the software that we want to put these items on the screen for people to see.

SimpleGUI setup code

06 The last parts are purely for the interface. We tell the code what to do when a key is depressed and then released, and give it a frame to work in. The frame is then told what functions handle the graphics, key functions etc. Finally, we give it **frame.start()** so it starts.

Full code listing

```
import simpleguitk as simplegui
import random

w, h = 600, 400
tux_r = 20
pad_w= 8
pad_h = 80

def tux_spawn(right):
    global tux_pos, tux_vel
    tux_pos = [0,0]
    tux_vel = [0,0]
    tux_pos[0] = w/2
    tux_pos[1] = h/2
    if right:
        tux_vel[0] = random.randrange(2, 4)
    else:
        tux_vel[0] = -random.randrange(2, 4)
    tux_vel[1] = -random.randrange(1, 3)

def start():
    global paddle1_pos, paddle2_pos, ↵
paddle1_vel, paddle2_vel
    global score1, score2
    tux_spawn(random.choice([True, False]))
    score1, score2 = 0,0
    paddle1_vel, paddle2_vel = 0,0
    paddle1_pos, paddle2_pos = h/2, h/2

def draw(canvas):
    global score1, score2, paddle1_pos, ↵
paddle2_pos, tux_pos, tux_vel
    if paddle1_pos > (h - (pad_h/2)):
        paddle1_pos = (h - (pad_h/2))
    elif paddle1_pos < (pad_h/2):
        paddle1_pos = (pad_h/2)
    else:
        paddle1_pos += paddle1_vel
    if paddle2_pos > (h - (pad_h/2)):
        paddle2_pos = (h - (pad_h/2))
    elif paddle2_pos < (pad_h/2):
        paddle2_pos = (pad_h/2)
    else:
        paddle2_pos += paddle2_vel
    canvas.draw_line([w / 2, 0],[w / 2, h], 4, ↵
“Green”)
    canvas.draw_line([(pad_w/2), paddle1_ ↵
pos + (pad_h/2)], [(pad_w/2), paddle1_pos - ↵
(pad_h/2)], pad_w, “Green”)
    canvas.draw_line([w - (pad_w/2), ↵
paddle2_pos + (pad_h/2)], [w - (pad_w/2), ↵
paddle2_pos - (pad_h/2)], pad_w, “Green”)
    tux_pos[0] += tux_vel[0]
    tux_pos[1] += tux_vel[1]
    if tux_pos[1] <= tux_r or tux_pos[1] >= ↵
h - tux_r:
        tux_vel[1] = -tux_vel[1]*1.1
    if tux_pos[0] <= pad_w + tux_r:
        if (paddle1_pos+(pad_h/2)) >= ↵
tux_pos[1] >= (paddle1_pos-(pad_h/2)):
            tux_vel[0] = -tux_vel[0]*1.1
            tux_vel[1] *= 1.1
        else:
            score2 += 1
            tux_spawn(True)
    elif tux_pos[0] >= w - pad_w - tux_r:
        if (paddle2_pos+(pad_h/2)) >= ↵
tux_pos[1] >= (paddle2_pos-(pad_h/2)):
            tux_vel[0] = -tux_vel[0]
            tux_vel[1] *= 1.1
        else:
            score1 += 1
            tux_spawn(False)
    canvas.draw_image(tux, (265 / 2, 314 / 2), ↵
(265, 314), tux_pos, (45, 45))
    canvas.draw_text(str(score1), [150, 100], ↵
30, “Green”)
    canvas.draw_text(str(score2), [450, 100], ↵
30, “Green”)

def keydown(key):
    global paddle1_vel, paddle2_vel
    acc = 3
    if key == simplegui.KEY_MAP[“w”]:
        paddle1_vel -= acc
    elif key == simplegui.KEY_MAP[“s”]:
        paddle1_vel += acc
    elif key==simplegui.KEY_MAP[“down”]:
        paddle2_vel += acc
    elif key==simplegui.KEY_MAP[“up”]:
        paddle2_vel -= acc

def keyup(key):
    global paddle1_vel, paddle2_vel
    acc = 0
    if key == simplegui.KEY_MAP[“w”]:
        paddle1_vel = acc
    elif key == simplegui.KEY_MAP[“s”]:
        paddle1_vel = acc
    elif key==simplegui.KEY_MAP[“down”]:
        paddle2_vel = acc
    elif key==simplegui.KEY_MAP[“up”]:
        paddle2_vel = acc

frame = simplegui.create_frame(“Tux for Two”, ↵
w, h)
frame.set_draw_handler(draw)
frame.set_keydown_handler(keydown)
frame.set_keyup_handler(keyup)
tux = simplegui.load_image(‘http://upload. ↵
wikimedia.org/wikipedia/commons/a/af/Tux.png’)

start()
frame.start()
```

Program a Space Invaders clone

Write your own RasPi shooter in 300 lines of Python

What you'll need…

Raspbian
www.raspberrypi.org/downloads

Python
www.python.org/doc

Pygame
www.pygame.org/docs

When you're learning to program in a new language or trying to master a new module, experimenting with a familiar and relatively simply project is a very useful exercise to help expand your understanding of the tools you're using. Our Space Invaders clone is one such example that lends itself perfectly to Python and the Pygame module – it's a simple game with almost universally understood rules and logic.

We've tried to use many features of Pygame, which is designed to make the creation of games and interactive applications easier. We've extensively used the Sprite class, which saves dozens of lines of extra code in making collision detection simple and updating the screen and its many actors a single-line command.

Have fun with the project and make sure you tweak and change things to make it your own!

Did you know…

Space Invaders was one of the biggest arcade hits in the world. It's a great first game since everyone knows how to play!

SCORE 0
LIVES 3
PHILIPS

Right Pivaders is a Space Invaders clone we've made especially for the Pi

Full code listing

```
#!/usr/bin/env python2

import pygame, random

BLACK = (0, 0, 0)
BLUE = (0, 0, 255)
WHITE = (255, 255, 255)
RED = (255, 0, 0)
ALIEN_SIZE = (30, 40)
ALIEN_SPACER = 20
BARRIER_ROW = 10
BARRIER_COLUMN = 4
BULLET_SIZE  = (5, 10)
MISSILE_SIZE = (5, 5)
BLOCK_SIZE = (10, 10)
RES = (800, 600)

class Player(pygame.sprite.Sprite):
  def __init__(self):
    pygame.sprite.Sprite.__init__(self)
    self.size = (60, 55)
    self.rect = self.image.get_rect()
    self.rect.x = (RES[0] / 2) - (self.size ↵
[0] / 2)
    self.rect.y = 520
    self.travel = 7
    self.speed = 350
    self.time = pygame.time.get_ticks()

  def update(self):
    self.rect.x += GameState.vector * self. ↵
travel
    if self.rect.x < 0:
      self.rect.x = 0
    elif self.rect.x > RES[0] - self.size[0]:
      self.rect.x = RES[0] - self.size[0]

class Alien(pygame.sprite.Sprite):
  def __init__(self):
    pygame.sprite.Sprite.__init__(self)
    self.size = (ALIEN_SIZE)
    self.rect = self.image.get_rect()
    self.has_moved = [0, 0]
    self.vector = [1, 1]
    self.travel = [(ALIEN_SIZE[0] - 7), ↵
ALIEN_SPACER]
    self.speed = 700
    self.time = pygame.time.get_ticks()

  def update(self):
    if GameState.alien_time - self.time > ↵
self.speed:
      if self.has_moved[0] < 12:
        self.rect.x += self.vector[0] * self. ↵
travel[0]
        self.has_moved[0] +=1
      else:
        if not self.has_moved[1]:
          self.rect.y += self.vector[1] * ↵
self.travel[1]
        self.vector[0] *= -1
        self.has_moved = [0, 0]
        self.speed -= 20
        if self.speed <= 100:
          self.speed = 100
      self.time = GameState.alien_time

class Ammo(pygame.sprite.Sprite):
  def __init__(self, color, (width, height)):
    pygame.sprite.Sprite.__init__(self)
    self.image = pygame.Surface([width, ↵
height])
    self.image.fill(color)
    self.rect = self.image.get_rect()
    self.speed = 0
    self.vector = 0

  def update(self):
    self.rect.y += self.vector * self.speed
    if self.rect.y < 0 or self.rect.y > RES[1]:
      self.kill()

class Block(pygame.sprite.Sprite):
  def __init__(self, color, (width, height)):
    pygame.sprite.Sprite.__init__(self)
    self.image = pygame.Surface([width, ↵
height])
    self.image.fill(color)
    self.rect = self.image.get_rect()
class GameState:
  pass

class Game(object):
  def __init__(self):
    pygame.init()
    pygame.font.init()
    self.clock = pygame.time.Clock()
    self.game_font = pygame.font.Font(
    ‘data/Orbitracer.ttf’, 28)
    self.intro_font = pygame.font.Font(
    ‘data/Orbitracer.ttf’, 72)
    self.screen = pygame.display.set_ ↵
mode([RES[0], RES[1]])
    self.time = pygame.time.get_ticks()
    self.refresh_rate = 20
    self.rounds_won = 0
    self.level_up = 50
    self.score = 0
    self.lives = 2
    self.player_group = pygame.sprite.Group()
    self.alien_group = pygame.sprite.Group()
    self.bullet_group = pygame.sprite.Group()
    self.missile_group = pygame.sprite.Group()
    self.barrier_group = pygame.sprite.Group()
```

Continued on page 91

Setting up dependencies

01 If you're looking to get a better understanding of programming games with Python and Pygame, we strongly recommend you copy the Pivaders code in this tutorial into your own program. It's great practice and gives you a chance to tweak elements of the game to suit you, be it a different ship image, changing the difficulty or the ways the alien waves behave. If you just want to play the game, that's easily achieved too, though. Either way, the game's only dependency is Pygame, which (if it isn't already) can be installed from the terminal by typing:

```
sudo apt-get install python-pygame
```

Installation

02 For Pivaders we've used Git, a brilliant form of version control used to safely store the game files and retain historical versions of your code. Git should already be installed on your Pi; if not, you can acquire it by typing:

```
sudo apt-get install git
```

As well as acting as caretaker for your code, Git enables you to clone copies of other people's projects so you can work on them, or just use them. To clone Pivaders, go to your home folder in the terminal (`cd ~`), make a directory for the project (mkdir pivaders), enter the directory (cd pivaders) and type:

```
git pull https://github.com/russb78/pivaders.git
```

Testing Pivaders

03 With Pygame installed and the project cloned to your machine (you can also find the .zip on this issue's cover DVD – simply unpack it and copy it to your home directory to use it), you can take it for a quick test drive to make sure everything's set up properly. All you need to do is type python pivaders.py from within the pivaders directory in the terminal to get started. You can start the game with the space bar, shoot with the same button and simply use the left and right arrows on your keyboard to move your ship left and right.

Creating your own clone

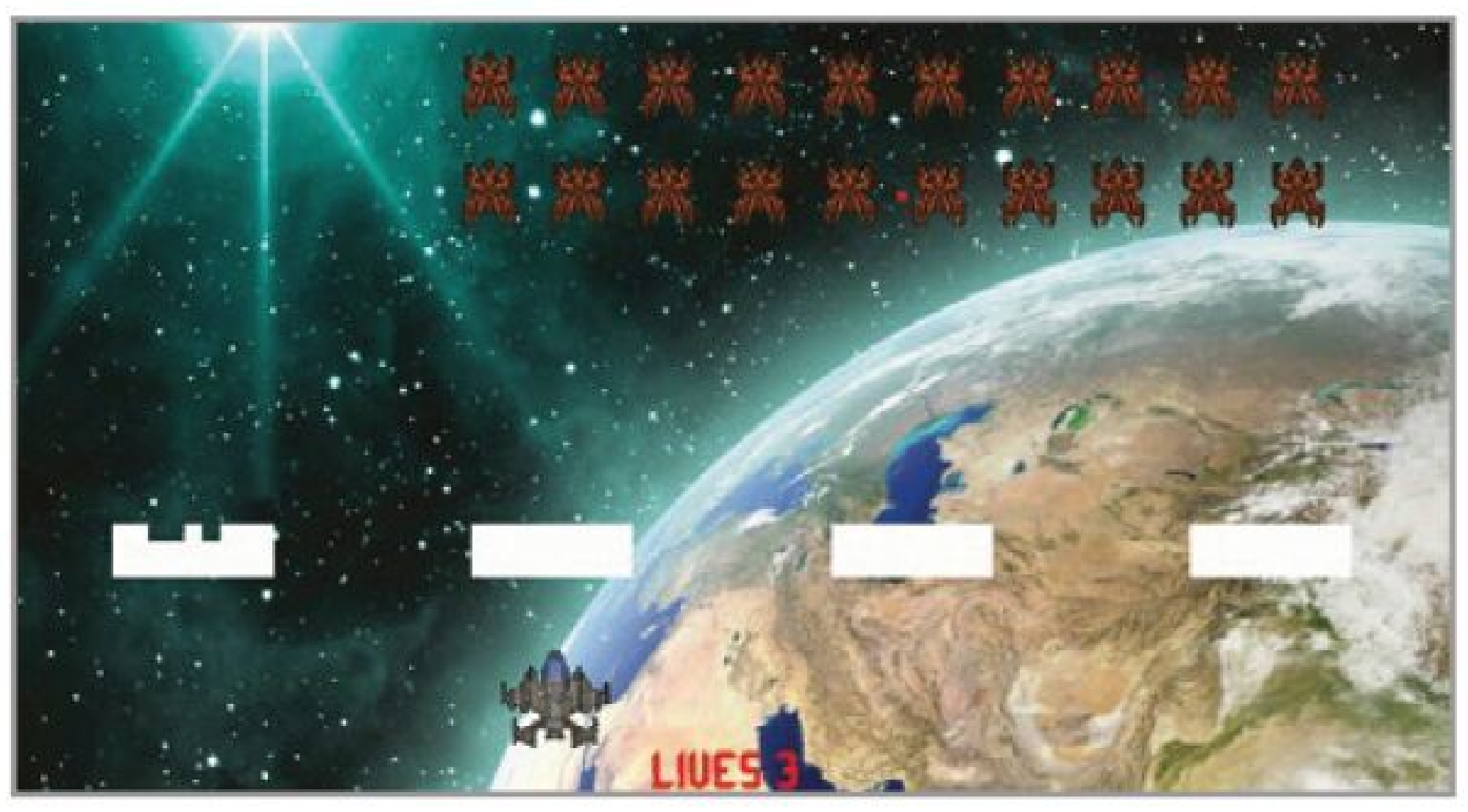
04 Once you've racked up a good high score (anything over 2,000 points is respectable) and got to know our simple implementation, you'll get more from following along with and exploring the code and our brief explanations of what's going on. For those who want to make their own project, create a new project folder and use either IDLE or Leafpad (or perhaps install Geany) to create and save a .py file of your own.

Global variables & tuples

05 Once we've imported the modules we need for the project, there's quite a long list of variables in block capitals. The capitals denote that these variables are constants (or global variables). These are important numbers that never change – they represent things referred to regularly in the code, like colours, block sizes and resolution. You'll also notice that colours and sizes hold multiple numbers in braces – these are tuples. You could use square brackets (to make them lists), but we use tuples here since they're immutable, which means you can't reassign individual items within them. Perfect for constants, which aren't designed to change anyway.

Classes – part 1

06 A class is essentially a blueprint for an object you'd like to make. In the case of our player, it contains all the required info, from which you can make multiple copies (we create a player instance in the make_player() method halfway through the project). The great thing about the classes in Pivaders is that they inherit lots of capabilities and shortcuts from Pygame's Sprite class, as denoted by the pygame.sprite. Sprite found within the braces of the first line of the class. You can read the docs to learn more about the Sprite class via **www.pygame.org/docs/ref/sprite.html**.



> "We've tried to use many features of Pygame, which is designed to make the creation of games and interactive applications easier"

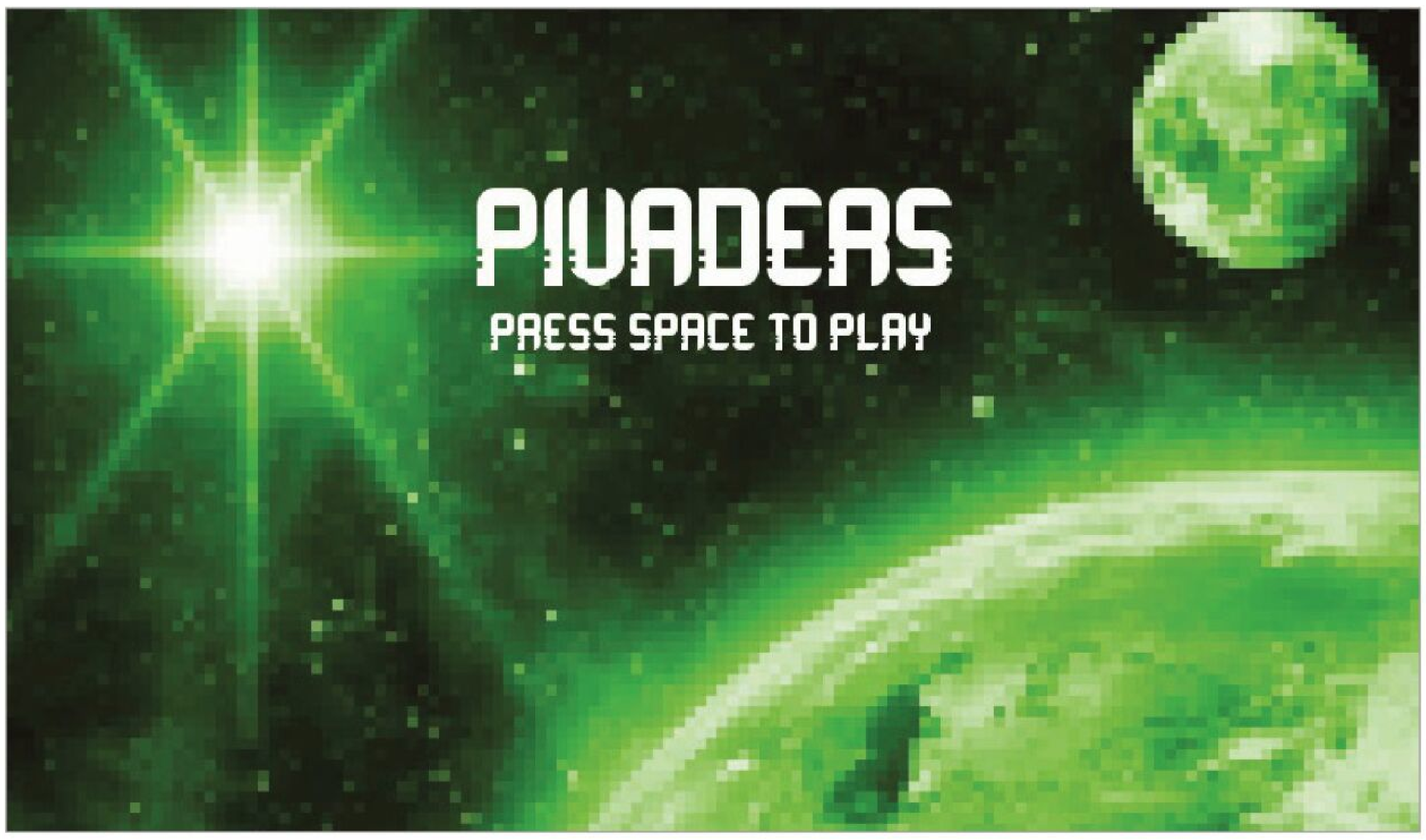
Continued from page 89

```
        self.all_sprite_list = pygame.sprite. ↵
Group()
        self.intro_screen = pygame.image.load(
        ‘data/start_screen.jpg’).convert()
        self.background = pygame.image.load(
        ‘data/Space-Background.jpg’).convert()
        pygame.display.set_caption(‘Pivaders - ↵
ESC to exit’)
        pygame.mouse.set_visible(False)
        Player.image = pygame.image.load(
        ‘data/ship.png’).convert()
        Player.image.set_colorkey(BLACK)
        Alien.image = pygame.image.load(
        ‘data/Spaceship16.png’).convert()
        Alien.image.set_colorkey(WHITE)
        GameState.end_game = False
        GameState.start_screen = True
        GameState.vector = 0
        GameState.shoot_bullet = False

    def control(self):
        for event in pygame.event.get():
            if event.type == pygame.QUIT:
                GameState.start_screen = False
                GameState.end_game = True
            if event.type == pygame.KEYDOWN \
            and event.key == pygame.K_ESCAPE:
                if GameState.start_screen:
                    GameState.start_screen = False
                    GameState.end_game = True
                    self.kill_all()
                else:
                    GameState.start_screen = True
        self.keys = pygame.key.get_pressed()
        if self.keys[pygame.K_LEFT]:
            GameState.vector = -1
        elif self.keys[pygame.K_RIGHT]:
            GameState.vector = 1
        else:
            GameState.vector = 0
        if self.keys[pygame.K_SPACE]:
            if GameState.start_screen:
                GameState.start_screen = False
                self.lives = 2
                self.score = 0
                self.make_player()
                self.make_defenses()
                self.alien_wave(0)
            else:
                GameState.shoot_bullet = True

    def splash_screen(self):
        while GameState.start_screen:
            self.kill_all()
            self.screen.blit(self.intro_screen, ↵
[0, 0])
            self.screen.blit(self.intro_font.render(
            “PIVADERS”, 1, WHITE), (265, 120))
            self.screen.blit(self.game_font.render(
            “PRESS SPACE TO PLAY”, 1, WHITE), ↵
(274, 191))
            pygame.display.flip()
            self.control()

    def make_player(self):
        self.player = Player()
        self.player_group.add(self.player)
        self.all_sprite_list.add(self.player)

    def refresh_screen(self):
        self.all_sprite_list.draw(self.screen)
        self.refresh_scores()
        pygame.display.flip()
        self.screen.blit(self.background, [0, 0])
        self.clock.tick(self.refresh_rate)

    def refresh_scores(self):
        self.screen.blit(self.game_font.render(
        “SCORE “ + str(self.score), 1, WHITE), ↵
(10, 8))
        self.screen.blit(self.game_font.render(
        “LIVES “ + str(self.lives + 1), 1, RED), ↵
(355, 575))

    def alien_wave(self, speed):
        for column in range(BARRIER_COLUMN):
            for row in range(BARRIER_ROW):
                alien = Alien()
                alien.rect.y = 65 + (column * (
                ALIEN_SIZE[1] + ALIEN_SPACER))
                alien.rect.x = ALIEN_SPACER + (
                row * (ALIEN_SIZE[0] + ALIEN_SPACER))
                self.alien_group.add(alien)
                self.all_sprite_list.add(alien)
                alien.speed -= speed

    def make_bullet(self):
        if GameState.game_time - self.player. ↵
time > self.player.speed:
            bullet = Ammo(BLUE, BULLET_SIZE)
            bullet.vector = -1
            bullet.speed = 26
            bullet.rect.x = self.player.rect.x + 28
            bullet.rect.y = self.player.rect.y
            self.bullet_group.add(bullet)
            self.all_sprite_list.add(bullet)
            self.player.time = GameState.game_time
        GameState.shoot_bullet = False

    def make_missile(self):
        if len(self.alien_group):
            shoot = random.random()
            if shoot <= 0.05:
                shooter = random.choice([
                alien for alien in self.alien_group])
                missile = Ammo(RED, MISSILE_SIZE)
```

Continued on page 93

Classes – part 2

07 In Pivader's classes, besides creating the required attributes for the object, you'll also notice all the classes have an update() method apart from the Block class (a method is a function within a class). The update() method is called in every loop through the main game and simply asks the iteration of the class we've created to move. In the case of a bullet from the Ammo class, we're asking it to move down the screen. If it goes off either end, we destroy it.



Ammo

08 What's most interesting about classes, though, is that you can use one class to create lots of different things. You could, for example, have a pet class. From that class you could create a cat (that meows) and a dog (that barks). They're different in many ways, but they're both furry and have four legs, so can be created from the same parent class. We've done exactly that with our Ammo class, using it to create both the player bullets and the alien missiles. They're different colours and they shoot in opposite directions, but they're fundamentally one and the same.

The game

09 Our final class is called Game. This is where all the main functionality of the game itself comes in, but remember, so far this is still just a list of ingredients – nothing can actually happen until a 'Game' object is created (right at the bottom of the code). The Game class is where the central mass of the game resides, so we initialise Pygame, set the imagery for our protagonist and extraterrestrial antagonist and create some GameState attributes that we use to control key aspects of external classes, like changing the player's vector (direction).

The main loop

10 There are a lot of methods (class functions) in the Game class, and each is designed to control a particular aspect of either setting up the game or the gameplay itself. The logic that dictates what happens within any one round of the game is contained in the main_loop() method right at the bottom of the pivaders.py script and is the key to unlocking exactly what variables and functions you need for your game.

Main loop key logic – part 1

11 Firstly the game checks that the end_game attribute is false – if it's true, the entire loop in main_loop() is skipped and we go straight to pygame.quit(), exiting the game. This flag is set to true only if the player closes the game window or presses the Esc key when on the start_screen. Assuming end_game and start_screen are false, the main loop can start proper, with the control() method, which checks to see if the location of the player needs to change. Next we attempt to make an enemy missile and we use the random module to limit the number of missiles that can be created. Next we call the update() method for each and every actor on the screen using a simple for loop. This makes sure everyone's up to date and moved before we check collisions in calc_collisions().

Main loop key logic – part 2

12 Once collisions have been calculated, we need to see if the game is still meant to continue. We do so with is_dead() and defenses_breached() – if either of these methods returns true, we know we need to return to the start screen. On the other hand, we also need to check to see if we've killed all the aliens, from within win_round(). Assuming we're not dead, but the aliens are, we know we can call the next_round() method, which creates a fresh batch of aliens and increases their speed around the screen. Finally, we refresh the screen so everything that's been moved, shot or killed can be updated or removed from the screen. Remember, the main loop happens 20 times a second – so the fact we don't call for the screen to update right at the end of the loop is of no consequence.

Continued from page 91

```
        missile.vector = 1
        missile.rect.x = shooter.rect.x + 15
        missile.rect.y = shooter.rect.y + 40
        missile.speed = 10
        self.missile_group.add(missile)
        self.all_sprite_list.add(missile)

  def make_barrier(self, columns, rows, spacer):
    for column in range(columns):
      for row in range(rows):
        barrier = Block(WHITE, (BLOCK_SIZE))
        barrier.rect.x = 55 + (200 * spacer) ↵
+ (row * 10)
        barrier.rect.y = 450 + (column * 10)
        self.barrier_group.add(barrier)
        self.all_sprite_list.add(barrier)

  def make_defenses(self):
    for spacing, spacing in ↵
enumerate(xrange(4)):
      self.make_barrier(3, 9, spacing)

  def kill_all(self):
    for items in [self.bullet_group, self. ↵
player_group,
    self.alien_group, self.missile_group, ↵
self.barrier_group]:
      for i in items:
        i.kill()

  def is_dead(self):
    if self.lives < 0:
      self.screen.blit(self.game_font.render(
      “The war is lost! You scored: “ + str(
      self.score), 1, RED), (250, 15))
      self.rounds_won = 0
      self.refresh_screen()
      pygame.time.delay(3000)
      return True

  def win_round(self):
    if len(self.alien_group) < 1:
      self.rounds_won += 1
      self.screen.blit(self.game_font.render(
      “You won round “ + str(self.rounds_won) +
      “  but the battle rages on”, 1, RED), ↵
(200, 15))
      self.refresh_screen()
      pygame.time.delay(3000)
      return True

  def defenses_breached(self):
    for alien in self.alien_group:
      if alien.rect.y > 410:
        self.screen.blit(self.game_font.render(
        “The aliens have breached Earth ↵
defenses!”,
        1, RED), (180, 15))
        self.refresh_screen()
        pygame.time.delay(3000)
        return True

  def calc_collisions(self):
    pygame.sprite.groupcollide(
    self.missile_group, self.barrier_group, ↵
True, True)
    pygame.sprite.groupcollide(
    self.bullet_group, self.barrier_group, ↵
True, True)
    if pygame.sprite.groupcollide(
    self.bullet_group, self.alien_group, ↵
True, True):
      self.score += 10
    if pygame.sprite.groupcollide(
    self.player_group, self.missile_group, ↵
False, True):
      self.lives -= 1

  def next_round(self):
    for actor in [self.missile_group,
    self.barrier_group, self.bullet_group]:
      for i in actor:
        i.kill()
    self.alien_wave(self.level_up)
    self.make_defenses()
    self.level_up += 50

  def main_loop(self):
    while not GameState.end_game:
      while not GameState.start_screen:
        GameState.game_time = pygame.time. ↵
get_ticks()
        GameState.alien_time = pygame.time. ↵
get_ticks()
        self.control()
        self.make_missile()
        for actor in [self.player_group, ↵
self.bullet_group,
        self.alien_group, self.missile_group]:
          for i in actor:
            i.update()
        if GameState.shoot_bullet:
          self.make_bullet()
        self.calc_collisions()
        if self.is_dead() or self.defenses_ ↵
breached():
          GameState.start_screen = True
        if self.win_round():
          self.next_round()
        self.refresh_screen()
      self.splash_screen()
    pygame.quit()

if __name__ == ‘__main__’:
  pv = Game()
  pv.main_loop()
```

Pivaders Pt 2: graphics & sound

This time we'll expand our Space Invaders clone to include immersive animation and sound

We had great fun creating our basic Space Invaders clone, Pivaders, in the previous guide. Pygame's ability to group, manage and detect collisions thanks to the Sprite class really made a great difference to our project, not just in terms of code length, but in simplicity too. If you missed the first part of the project, you can find the v0.1 code listing on GitHub via **git.io/cBVTBg**, while you can find version v0.2 of the code, including all the images, music and sound effects we've used at **git.io/8QsK-w**.

To help keep our project code manageable and straightforward (as your projects grow keeping your code easy to follow becomes increasingly harder) we integrated a few animation methods into our Game class and opted to use a sprite sheet. Not only does it make it very easy to draw to the screen, but it also keeps the asset count under control and keeps performance levels up, which is especially important for the Raspberry Pi. We hope you have fun using our techniques to add animation and sound to your projects!

What you'll need…

Raspbian
www.raspberrypi.org/downloads

Python
www.python.org/doc

Pygame
www.pygame.org/docs

Art assets
opengameart.org

Did you know…

Space Invaders is one of the most cloned games in the world! It makes a great first project for game programmers.

Setting up dependencies

01 You'll get much more from the exercise if you download the code (**git.io/8QsK-w**) and use it for reference as you create your own animations and sound effects. Regardless of whether you just want to simply preview and play or walk-through the code to get a better understanding of basic game creation, you're still going to need to satisfy some basic dependencies. The two key requirements here are Pygame and Git, both of which are installed by default on up-to-date Raspbian installations. That's easy!

Downloading pivaders

02 Git is a superb version control solution that helps programmers safely store their code and associated files. Not only does it help you retain a full history of changes, it means you can 'clone' entire projects to use and work on from places like **github.com**. To clone the version of the project we created for this tutorial, go to your home folder from the command line (cd ~) and type:

```
git pull  https://github.com/russb78/pivaders.git
```

This creates a folder called pivaders.

Navigating the project

03 Within pivaders sits a licence, readme and a second pivaders folder. This contains the main game file, pivaders.py, which launches the application. Within the data folder you'll find subfolders for both graphics and sound assets, as well as the font we've used for the title screen and scores. To take pivaders for a test-drive, simply enter the pivaders subdirectory (cd pivaders/pivaders) and type:

```
python pivaders.py
```

Use the arrow keys to steer left and right and the space bar to shoot. You can quit with the Escape key.

Code listing (starting from line 87)

```
class Game(object):
    def __init__(self):
        pygame.init()
        pygame.font.init()
        self.clock = pygame.time.Clock()
        self.game_font = pygame.font.Font(
        ‘data/Orbitracer.ttf’, 28)
        self.intro_font = pygame.font.Font(
        ‘data/Orbitracer.ttf’, 72)
        self.screen = pygame.display.set_mode([RES[0], RES[1]])
        self.time = pygame.time.get_ticks()
        self.refresh_rate = 20; self.rounds_won = 0
        self.level_up = 50; self.score = 0
        self.lives = 2
        self.player_group = pygame.sprite.Group()
        self.alien_group = pygame.sprite.Group()
        self.bullet_group = pygame.sprite.Group()
        self.missile_group = pygame.sprite.Group()
        self.barrier_group = pygame.sprite.Group()
        self.all_sprite_list = pygame.sprite.Group()
        self.intro_screen = pygame.image.load(
        ‘data/graphics/start_screen.jpg’).convert()
        self.background = pygame.image.load(
        ‘data/graphics/Space-Background.jpg’).convert()
        pygame.display.set_caption(‘Pivaders - ESC to exit’)
        pygame.mouse.set_visible(False)
        Alien.image = pygame.image.load(
        ‘data/graphics/Spaceship16.png’).convert()
        Alien.image.set_colorkey(WHITE)
        self.ani_pos = 5 # 11 images of ship
        self.ship_sheet = pygame.image.load(
        ‘data/graphics/ship_sheet_final.png’).convert_alpha()
        Player.image = self.ship_sheet.subsurface(
                    self.ani_pos*64, 0, 64, 61)
        self.animate_right = False
        self.animate_left = False
        self.explosion_sheet = pygame.image.load(
        ‘data/graphics/explosion_new1.png’).convert_alpha()
        self.explosion_image = self.explosion_sheet.subsurface(
0, 0, 79, 96)
        self.alien_explosion_sheet = pygame.image.load(
        ‘data/graphics/alien_explosion.png’)
        self.alien_explode_graphics = self.alien_explosion_sheet.↵
subsurface(0, 0, 94, 96)
        self.explode = False
        self.explode_pos = 0; self.alien_explode = False
        self.alien_explode_pos = 0
        pygame.mixer.music.load(‘data/sound/10_Arpanauts.ogg’)
        pygame.mixer.music.play(-1)
        pygame.mixer.music.set_volume(0.7)
        self.bullet_fx = pygame.mixer.Sound(
        ‘data/sound/medetix__pc-bitcrushed-lazer-beam.ogg’)
        self.explosion_fx = pygame.mixer.Sound(
        ‘data/sound/timgormly__8-bit-explosion.ogg’)
        self.explosion_fx.set_volume(0.5)
        self.explodey_alien = []
```

Continued on page 96

Animation & sound

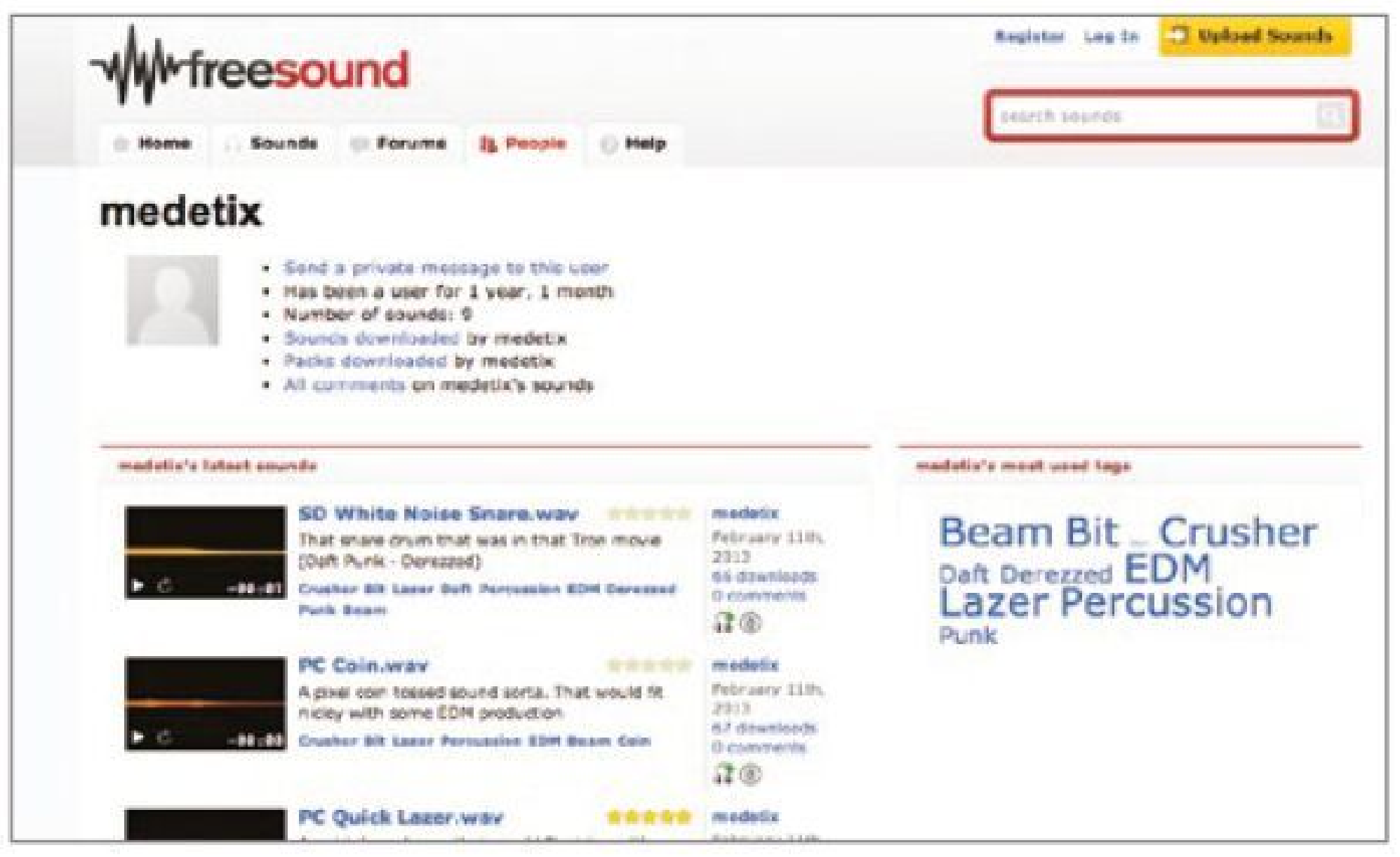
04 Compared with the game from last month's tutorial, you'll see it's now a much more dynamic project. The ship now leans into the turns as you change direction and corrects itself when stationary. When you shoot an alien ship, it explodes with several frames of animation and should you take fire, a smaller explosion occurs on your ship. Music, lasers and explosion sound effects also accompany the animations as they happen.

Finding images to animate

05 Before we can program anything, it's wise to have assets set up correctly. We've opted to use sprite sheets; these can be found online or created with GIMP with a little practice. They're a mosaic made up of individual 'frames' of equally sized and spaced images representing each frame. We found ours at **opengameart.org**.

Tweaking assets

06 While many of the assets you'll find online can be used as is, you may want to import them into an image-editing application like GIMP to configure them to suit your needs. We started with the central ship sprite and centred it into a new window. We set the size and width of the frame and then copy-pasted the other frames either side of it. We ended up with 11 frames of exactly the same size and width in a single document. Pixel-perfect precision on size and width is key, so we can just multiply it to find the next frame.



medetix

- Send a private message to this user
- Has been a user for 1 year, 1 month
- Number of sounds: 9
- Sounds downloaded by medetix
- Packs downloaded by medetix
- All comments on medetix's sounds

SD White Noise Snare.wav
That snare drum that was in that Tron movie (Daft Punk - Derezzed)

PC Coin.wav
A pixel coin tossed sound sorta. That would fit nicely with some EDM production

PC Quick Lazer.wav

Beam Bit Crusher Daft Derezzed EDM Lazer Percussion Punk

Loading the sprite sheet

07 Since we're inheriting from the Sprite class to create our Player class, we can easily alter how the player looks on screen by changing Player.image. First, we need to load our ship sprite sheet with pygame.image.load(). Since we made our sheet with a transparent background, we can append .convert_alpha() to the end of the line so the ship frames render correctly (without any background). We then use subsurface to set the initial Player.image to the middle ship sprite on the sheet. This is set by self.ani_pos, which has an initial value of 5. Changing this value will alter the ship image drawn to the screen: '0' would draw it leaning fully left, '11' fully to the right.

Animation flags

08 Slightly further down the list in the initialising code for the Game class, we also set two flags for our player animation: self.animate_left and self.animate_right. As you'll see in the Control method of our Game class, we use these to 'flag' when we want animations to happen with True and False. It also allows us to 'automatically' animate the player sprite back to its natural resting state (otherwise the ship will continue to look as if it's flying left when it has stopped).

The animation method

09 We use flags again in the code for the player: animate_player(). Here we use nested if statements to control the animation and physically set the player image. It states that if the animate_right flag is True and if the current animation position is different to what we want, we incrementally increase the ani_pos variable and set the player's image. The Else statement then animates the ship sprite back to its resting state and the same logic is then applied in the opposite direction.

```
    GameState.end_game = False
    GameState.start_screen = True
    GameState.vector = 0
    GameState.shoot_bullet = False

def control(self):
    for event in pygame.event.get():
        if event.type == pygame.QUIT:
            GameState.start_screen = False
            GameState.end_game = True
        if event.type == pygame.KEYDOWN \
        and event.key == pygame.K_ESCAPE:
            if GameState.start_screen:
                GameState.start_screen = False
                GameState.end_game = True
                self.kill_all()
            else:
                GameState.start_screen = True
    self.keys = pygame.key.get_pressed()
    if self.keys[pygame.K_LEFT]:
        GameState.vector = -1
        self.animate_left = True
        self.animate_right = False
    elif self.keys[pygame.K_RIGHT]:
        GameState.vector = 1
        self.animate_right = True
        self.animate_left = False
    else:
        GameState.vector = 0
        self.animate_right = False
        self.animate_left = False

    if self.keys[pygame.K_SPACE]:
        if GameState.start_screen:
            GameState.start_screen = False
            self.lives = 2
            self.score = 0
            self.make_player()
            self.make_defenses()
            self.alien_wave(0)
        else:
            GameState.shoot_bullet = True
            self.bullet_fx.play()

def animate_player(self):
    if self.animate_right:
        if self.ani_pos < 10:
            Player.image = self.ship_sheet.subsurface(
                self.ani_pos*64, 0, 64, 61)
            self.ani_pos += 1
    else:
        if self.ani_pos > 5:
            self.ani_pos -= 1
            Player.image = self.ship_sheet.subsurface(
                self.ani_pos*64, 0, 64, 61)

    if self.animate_left:
        if self.ani_pos > 0:
            self.ani_pos -= 1
```

```
                Player.image = self.ship_sheet.subsurface(
                    self.ani_pos*64, 0, 64, 61)
        else:
            if self.ani_pos < 5:
                Player.image = self.ship_sheet.subsurface(
                    self.ani_pos*64, 0, 64, 61)
                self.ani_pos += 1

    def player_explosion(self):
        if self.explode:
            if self.explode_pos < 8:
                self.explosion_image = self.explosion_sheet. ↵
subsurface(0, self.explode_pos*96, 79, 96)
                self.explode_pos += 1
                self.screen.blit(self.explosion_image, [self.player.
↵rect.x -10, self.player.rect.y - 30])
            else:
                self.explode = False
                self.explode_pos = 0

    def alien_explosion(self):
        if self.alien_explode:
            if self.alien_explode_pos < 9:
                self.alien_explode_graphics = self.alien_
explosion_ ↵sheet.subsurface(0, self.alien_explode_pos*96, 94,
96)
                self.alien_explode_pos += 1
                self.screen.blit(self.alien_explode_graphics, ↵
[int(self. explodey_alien[0]) - 50 , int(self.explodey_alien[1]) -
60])
            else:
                self.alien_explode = False
                self.alien_explode_pos = 0
                self.explodey_alien = []

    def splash_screen(self):
        while GameState.start_screen:
            self.kill_all()
            self.screen.blit(self.intro_screen, [0, 0])
            self.screen.blit(self.intro_font.render(
            "PIVADERS", 1, WHITE), (265, 120))
            self.screen.blit(self.game_font.render(
            "PRESS SPACE TO PLAY", 1, WHITE), (274, 191))
            pygame.display.flip()
            self.control()
            self.clock.tick(self.refresh_rate / 2)

    def make_player(self):
        self.player = Player()
```

Find the rest of the code at github.com/russb78/pivaders

> "Sprite sheets make it easy to draw to the screen, but it also keeps the asset count down and performance levels up"

Animating explosions

10 The player_explosion() and alien_explosion() methods that come after the player animation block in the Game class are similar but simpler executions of the same thing. As we only need to run through the same predefined set of frames (this time vertically), we only need to see if the self.explode and self.alien_explode flags are True before we increment the variables that change the image.

Adding music

11 Pygame makes it easy to add a musical score to a project. Just obtain a suitable piece of music in your preferred format (we found ours via freemusicarchive.org) and load it using the Mixer Pygame class. As it's already been initialised via pygame.init(), we can go ahead and load the music. The music.play(-1) requests that the music should start with the app and continue to loop until it quits. If we replaced -1 with 5, the music would loop five times before ending. Learn more about the Mixer class via **www.pygame.org/docs/ref/mixer.html.**

Using sound effects

12 Loading and using sounds is similar to how we do so for images in Pygame. First we load the sound effect using a simple assignment. For the laser beam, the initialisation looks like this:

```
self.bullet_fx = pygame.
mixer.Sound('location/of/file')
```

Then we simply trigger the sound effect at the appropriate time. In the case of the laser, we want it to play whenever we press the space bar to shoot, so we place it in the Game class's Control method, straight after we raise the shoot_bullet flag. You can get different sounds from **www.freesound.org**.

Use Python with Pi

Amazing creations with Python code and Raspberry Pi

From the tutorials up to this point, you'll have a firm grounding in Python. Now we're going to add the Raspberry Pi computer. First you'll learn how to get started with Python on the Pi, and then you'll discover exciting projects such as learning to multi-task with your Raspberry Pi (p.110), creating a Pi-powered virtual reality setup (p.114) and using it to get more out of Minecraft (p.106).

What you'll need…

A Raspberry Pi with all necessary peripherals

SD card with latest Debian image for Pi
www.raspberrypi.org/downloads

Using Python on Raspberry Pi

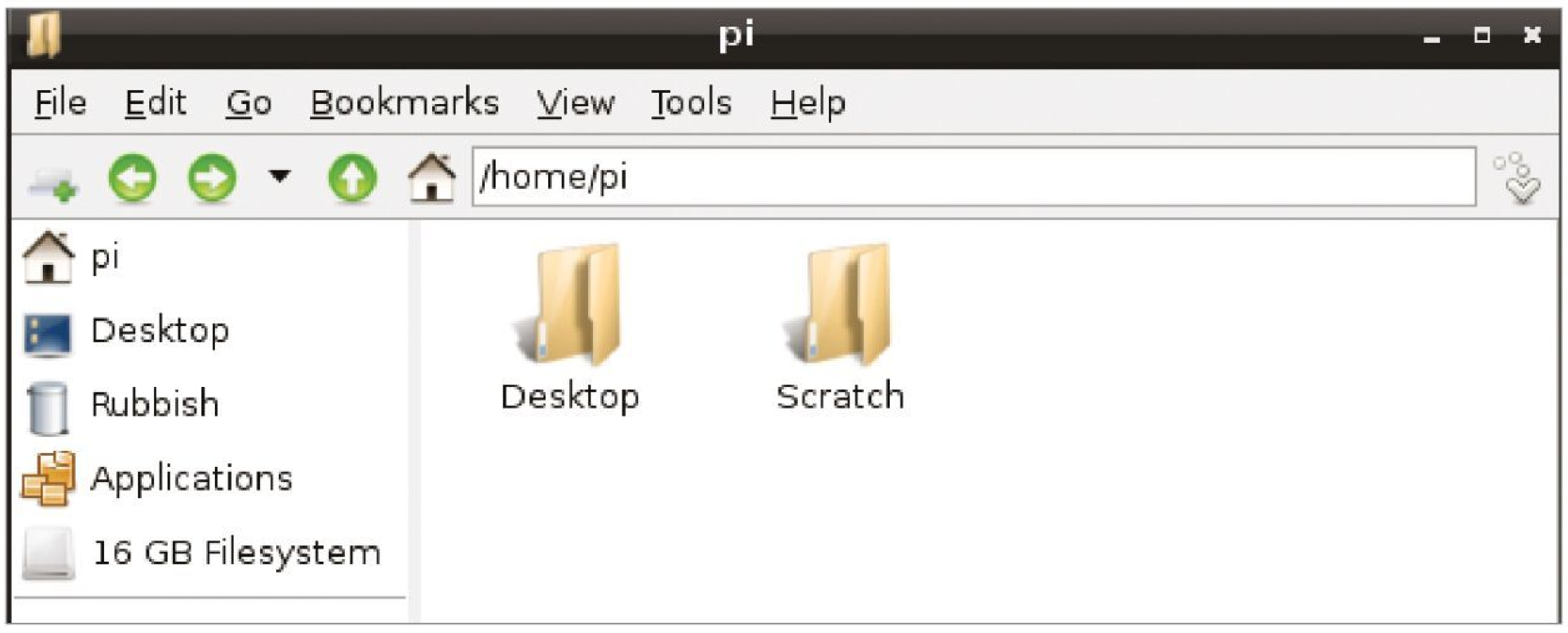
Program in Python with the Raspberry Pi, and lay the foundations for all your future projects

Before getting started with this tutorial, ensure that you've set up the latest version of the Raspbian operating system on an SD card for your Raspberry Pi. The beauty of using an SD card image is that the operating system is ready to go and a development environment is already configured for us.

We'll use a lightweight integrated development environment (IDE) called Geany for our Python development. Geany provides a friendlier interface compared to text-based editors such as nano to make it easier to get into the swing of things. This tutorial will cover topics such as:

- Basic arithmetic
- Comparison operators, for example 'equal to' and 'not equal to'
- Control structures, for example loops and if statements

By the end, we'll have an advanced version of our 'hello world' application. Let's dive straight in…



Staying organised

01 We don't want to have messy folders on our new Pi, so let's go to the file manager and organise ourselves. Open the file manager by clicking the icon next to the menu icon on the bottom left of the screen. Create a new folder by right-clicking and selecting New>Folder, then type a name and click OK. We created a folder called Python, and inside that created a folder called Hello World v2.

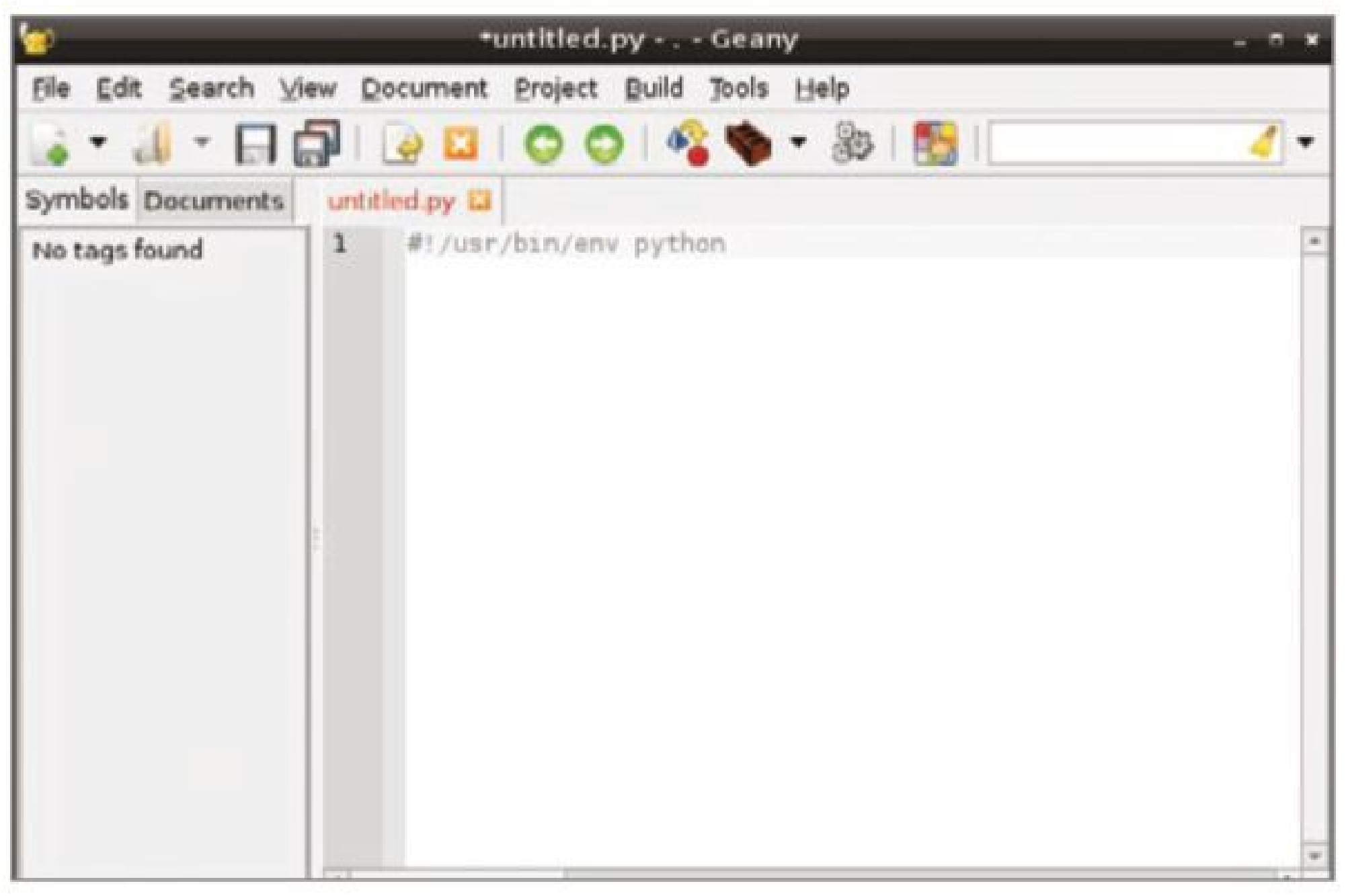
It's good practice to describe what the program's purpose is at the top of the file. This will help you out when working on larger projects with multiple files

It's important to think about data types. We convert the number to decimal to make sure that we don't lose any decimal numbers during arithmetic

The stopping condition for a while loop has to be satisfied at some point in the code; otherwise the loop will never end!

The print function can only accept string data types, so we need to convert any variables with a number data type to a string before we can print them to the screen

```
#!/usr/bin/env python

# An advanced Hello World program that will demonstrate the basics of
# programming in Python via a series of examples. Created by Liam Fraser
# for Linux User and Developer - 22/04/2012.

# Import the sys libary for the sys.exit function
import sys
# Import everything from the Decimal libary
from decimal import *

# Get the users first name and output a welcome message
firstName = raw_input("Please enter your first name: ")
print("Welcome " + firstName + "\n")

# Ask the user for a number and square it, double it and halve it
number = raw_input("Please enter a number: ")
number = Decimal(number)
numberHalved = number / 2
numberDoubled = number * 2
numberSquared = number * number

# Print out the values we just worked out, converting each float value
# to a string
print("The result of halving that number: " + str(numberHalved))
print("The result of doubling that number: " + str(numberDoubled))
print("The result of squaring that number: " + str(numberSquared))
print("")

# The stopping condition for a while loop
yesOrNo = False

# A while loop that will run untill a user enters either "yes" or "no"
while yesOrNo == False:
    result = raw_input("Do you want to continue? (yes/no) ")

    if result == "yes" or result == "no":
        yesOrNo = True
    else:
        print("Error, please type yes or no" + "\n")

# Deal with the result
if result == "yes":
    print("\nContinuing")
else:
    print("\nExiting")
    sys.exit()

# Create the count which will be a stopping condition for a while loop
count = 1

# Use a while loop to add 5 to the number and output the value each time
print ("Incrementing the number by 5\n")

while count <= 5:
    number += 1
    print("number + " + str(count) + " = " + str(number))

    # Increment the count
    count += 1

# Finish off by printing that we are exiting
print("\nExiting")
```



```
#!/usr/bin/env python
```

Starting Geany

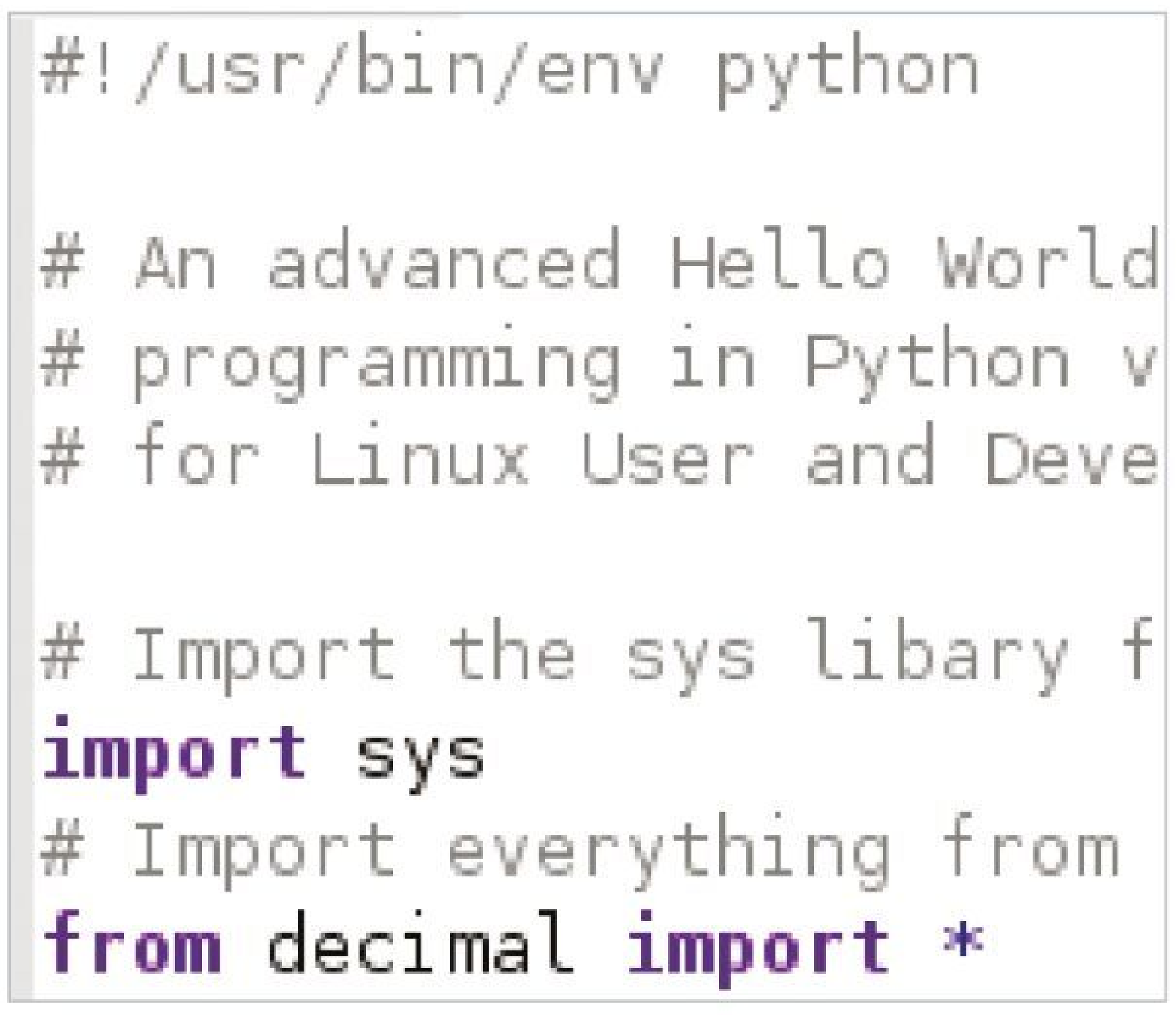
02 Start Geany by going to the LXDE menu and going to Programs. From here, select Geany. Once you're in the Geany interface, create a new Python file from a template by selecting 'New (with template)>main.py'. Delete everything in this template apart from the first line: #!/usr/bin/env python. This line is important because it means you can run the code from the command line and the Bash shell will know to open it with the Python interpreter.

Saving your work

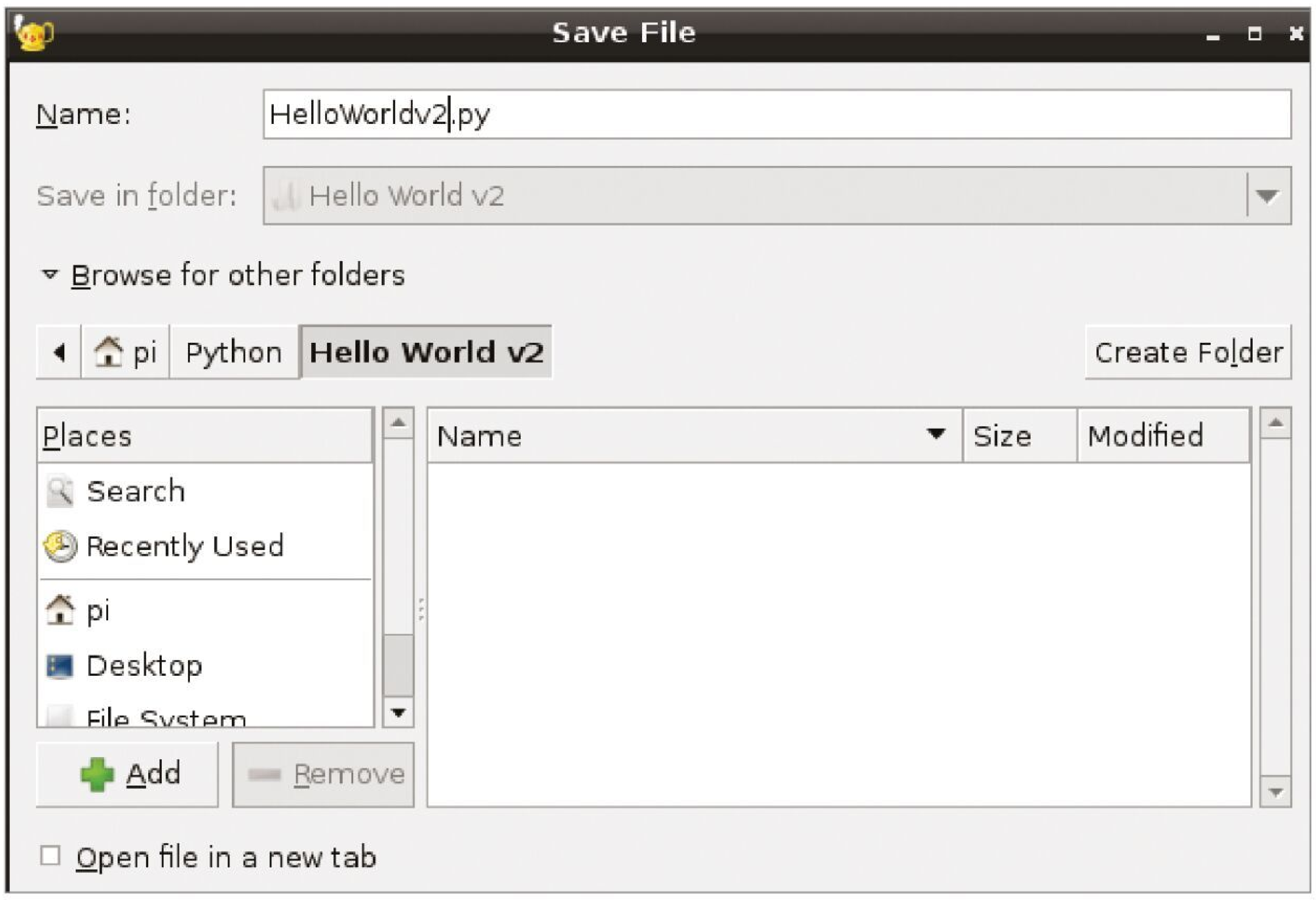
03 It's always a good idea to keep saving your work with Ctrl+S as you program, because it would be a shame to lose anything you've been working on. To save your file for the first time, either press Ctrl+S or go to the File menu and select Save. Give the file a sensible name and save it in the tidy folder structure you created before. It's a good habit to be well organised when programming, because it makes things much easier when your projects become bigger and more complicated.

Setting it up

04 Having detailed comments in your code is important because it allows you to note down things you find confusing and document complex procedures. If another programmer has to work with your code in the future, they'll be extremely grateful. Start by adding a comment with a description of what the program will do and your name. All comment lines start with a hash (#) and are not interpreted as code by the Python interpreter. We import the sys library so we can use the sys.exit function to close the program later on. We also import everything from the decimal library because we want to make use of the decimal type.



```
#!/usr/bin/env python

# An advanced Hello World
# programming in Python v
# for Linux User and Deve

# Import the sys libary f
import sys
# Import everything from
from decimal import *
```



Name: HelloWorldv2.py

Save in folder: Hello World v2

> "It's a good habit to be well organised when programming"

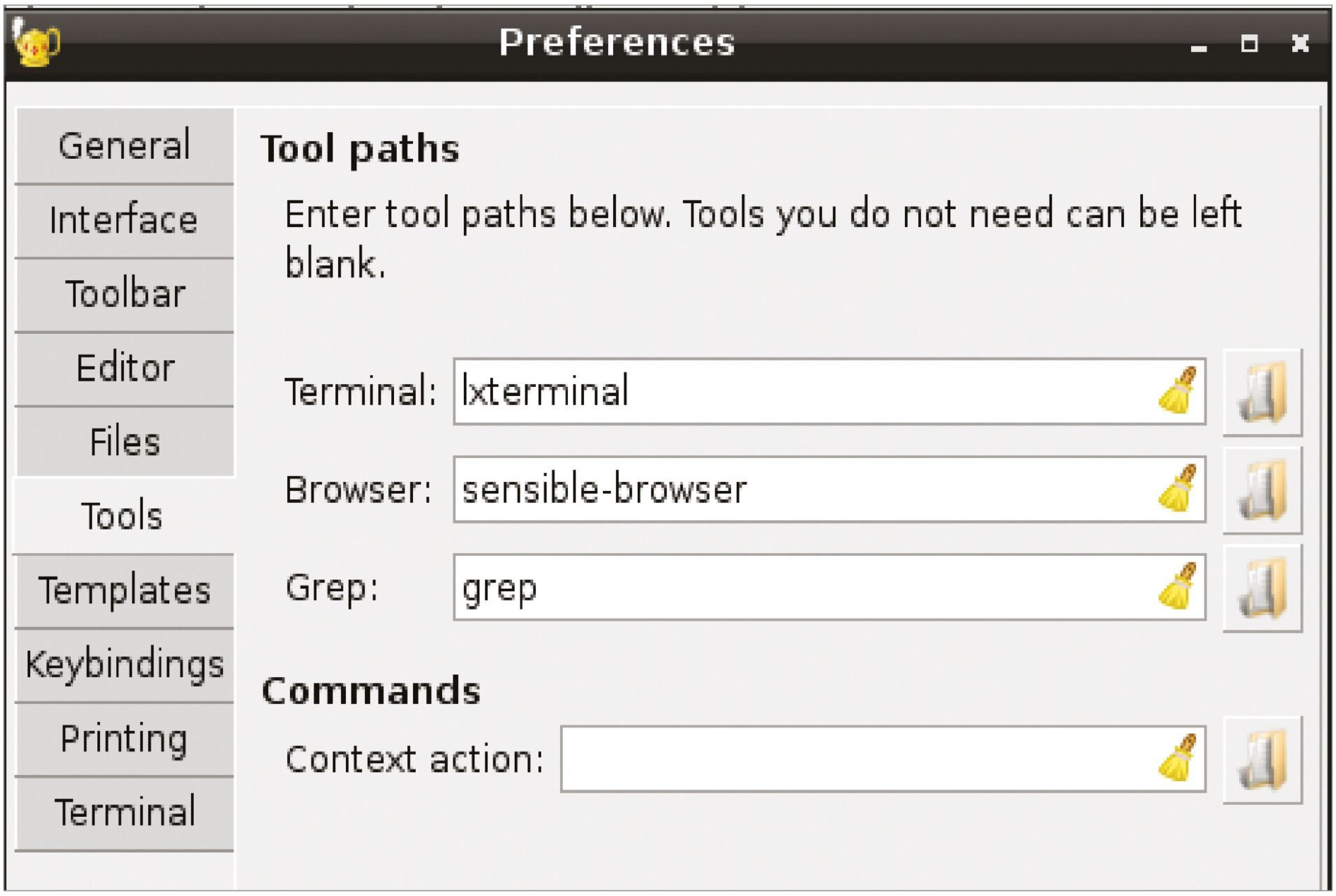
Variables

05 A variable is data that is stored in memory and can be accessed via a name. Our program is going to start by asking for your first name, store that in a variable and then print out a welcome message. We're going to add a comment that explains this and create a variable called firstName. Notice how we've capitalised the first letter of the second word to make it easier to read.

We want the firstName variable to hold the value returned by a function called raw_input, that will ask the user for input. The question is passed into the print function within brackets, and because this is a string it is enclosed within quotation marks. A string type is basically a collection of characters. Note the extra space we've added after the colon because the user types their input straight after this question.

Printing a message

06 Now that we have a value in firstName, we need to output a welcome message to the screen. We print to the screen in Python using the print function. The print function is followed by a pair of brackets which enclose the values to print. When using the addition operator with strings, they are joined together. Note how firstName doesn't need to be enclosed by quotation marks because it is the name of a variable. If it was enclosed in quotation marks, the text firstName would be output. We finish off by adding a '\n' character (new line character) to our output to leave one blank line before we start our next example.



Tool paths

Enter tool paths below. Tools you do not need can be left blank.

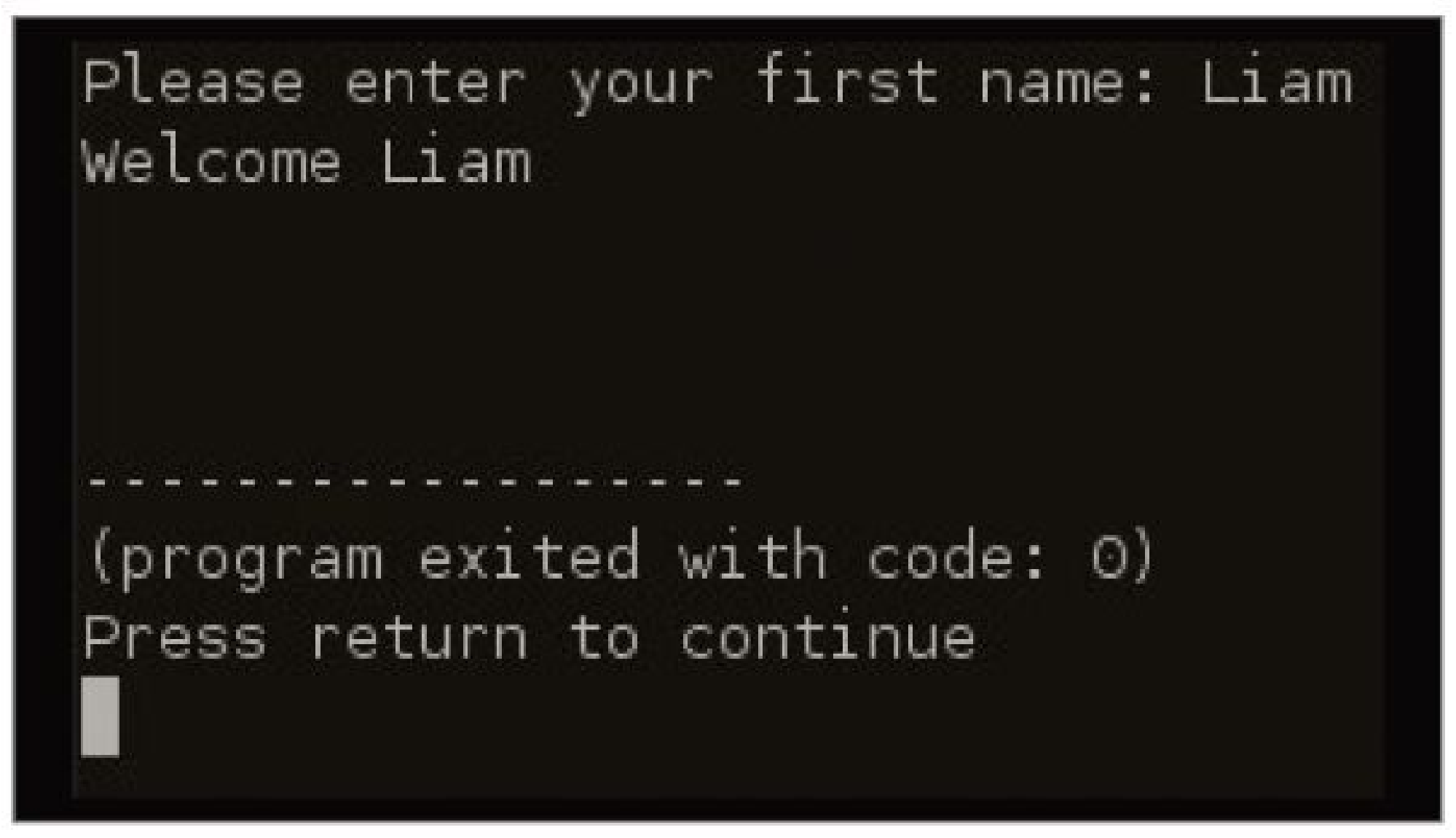
Terminal: lxterminal

Browser: sensible-browser

Grep: grep

Commands

Context action:



```
Please enter your first name: Liam
Welcome Liam



------------------
(program exited with code: 0)
Press return to continue
```

Fixing a small issue

07 The Debian image that we're currently using has a small misconfiguration issue in Geany. You'll know if you have this problem by trying to run your program with either the F5 key or going to the Build menu and selecting Execute. If the issue is present then nothing will happen and you'll see a message saying 'Could not find terminal: xterm'. Not to worry, it's easy to fix. Go to the Edit menu and then select Preferences. Go to the Tools tab and change the value for Terminal from xterm to lxterminal.

Testing our program

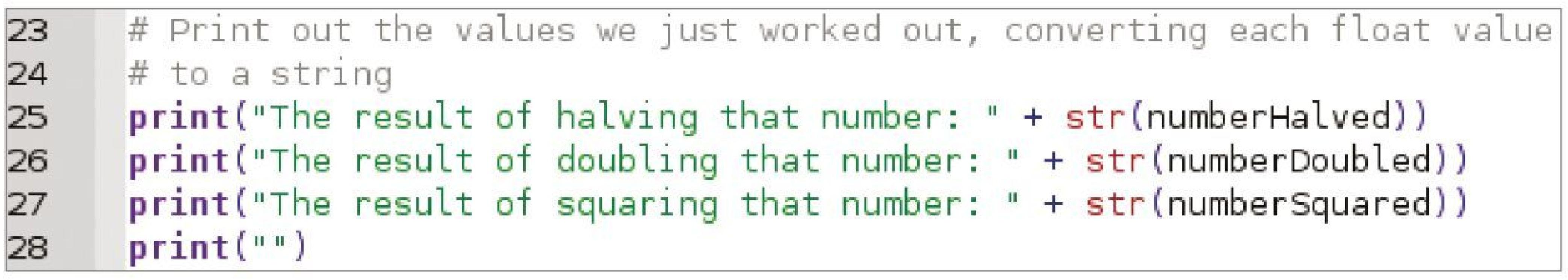
08 Now we've done that part, why not test it? It's worth noting that you have to save before running the program, or anything you've done since you last saved won't be interpreted by Python. Run the program by pressing the F5 key. Input your name by typing it and then pressing the Enter key. Once you have done this, you'll see a welcome message. If the program exits with the code 0 then everything was run successfully. Press Enter to close the terminal.

Working with numbers

09 We're going to ask the user for a number by basically repeating the first couple of lines we did. Once the user gives us a number, we'll halve, square and double it. The raw_input function returns the value that the user input as a string. A string is a text-based value so we can't perform arithmetic on it. The integer type in Python can only store whole numbers whereas the decimal type can store numbers with decimals. We're going to do something called a type cast, which basically converts a value with one type to another type. We're going to convert our number string to a decimal value because it's likely that decimals will be involved if we are halving numbers. If the number was of an integer type, any decimal values would simply be cut off the end, without any rounding. This is called truncation.

Performing arithmetic

10 The main arithmetic operators in Python are + - / *, the latter two being divide and multiply respectively. We've created three new variables called numberHalved, numberDoubled and numberSquared. Notice that we don't need to specify that they should be decimal because Python gives a type to its variables from the type of their initial value. The number variable is a decimal type, so all values returned from performing arithmetic on that number will also be of a decimal type.

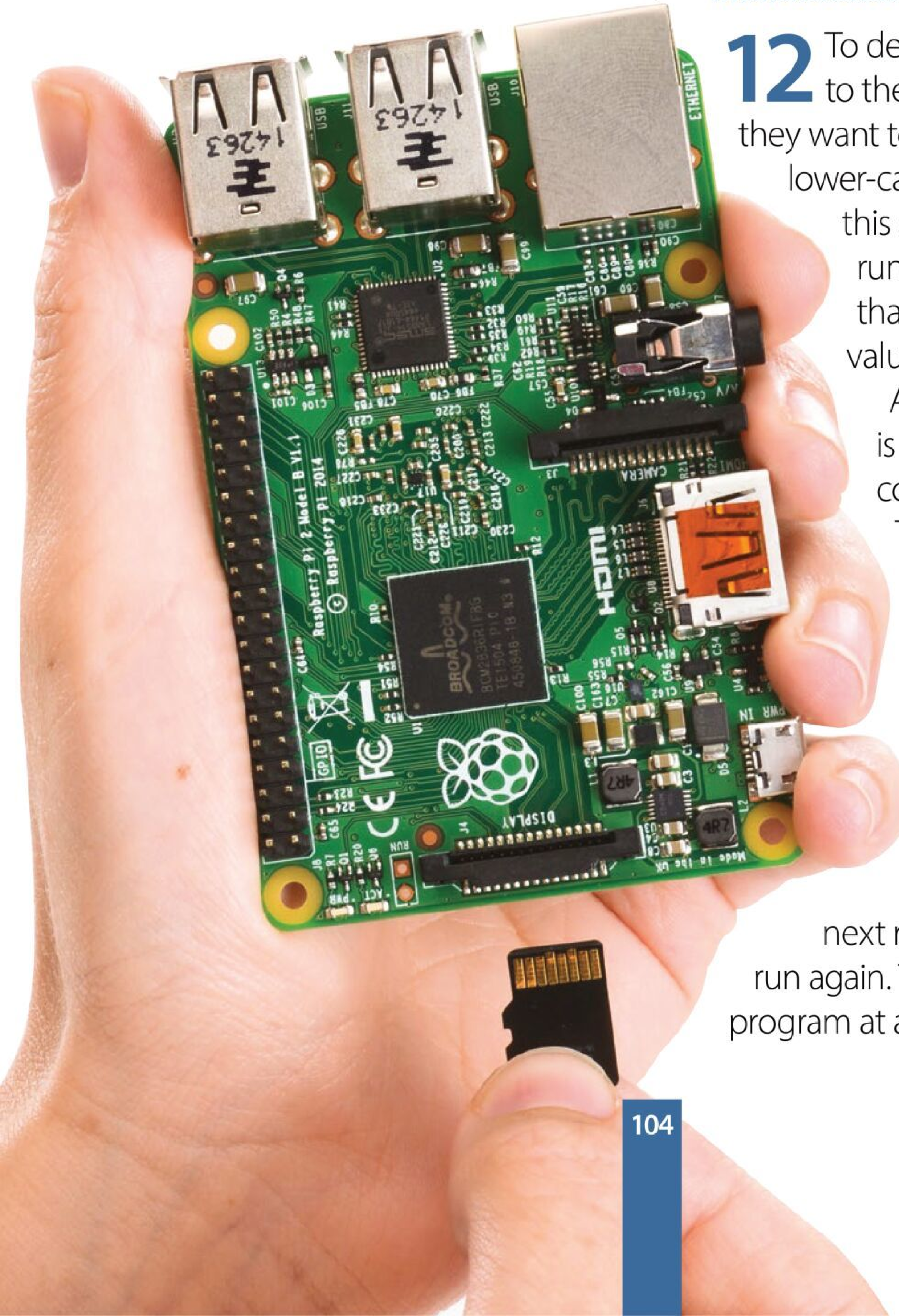


```python
# Print out the values we just worked out, converting each float value
# to a string
print("The result of halving that number: " + str(numberHalved))
print("The result of doubling that number: " + str(numberDoubled))
print("The result of squaring that number: " + str(numberSquared))
print("")
```

Printing our numbers

11 Now that we have performed our arithmetic, we need to print the results using the print function. The print function only accepts string values passed to it. This means that we need to convert each decimal value to a string using the str() function before they can be printed. We're using a print statement with nothing between the quotation marks to print one blank line. This works because the print function always adds a new line at the end of its output unless told otherwise, so printing an empty string just prints a new line.

Below The Raspberry Pi takes the 'Pi' part of its name from its compatibility with the Python programming language

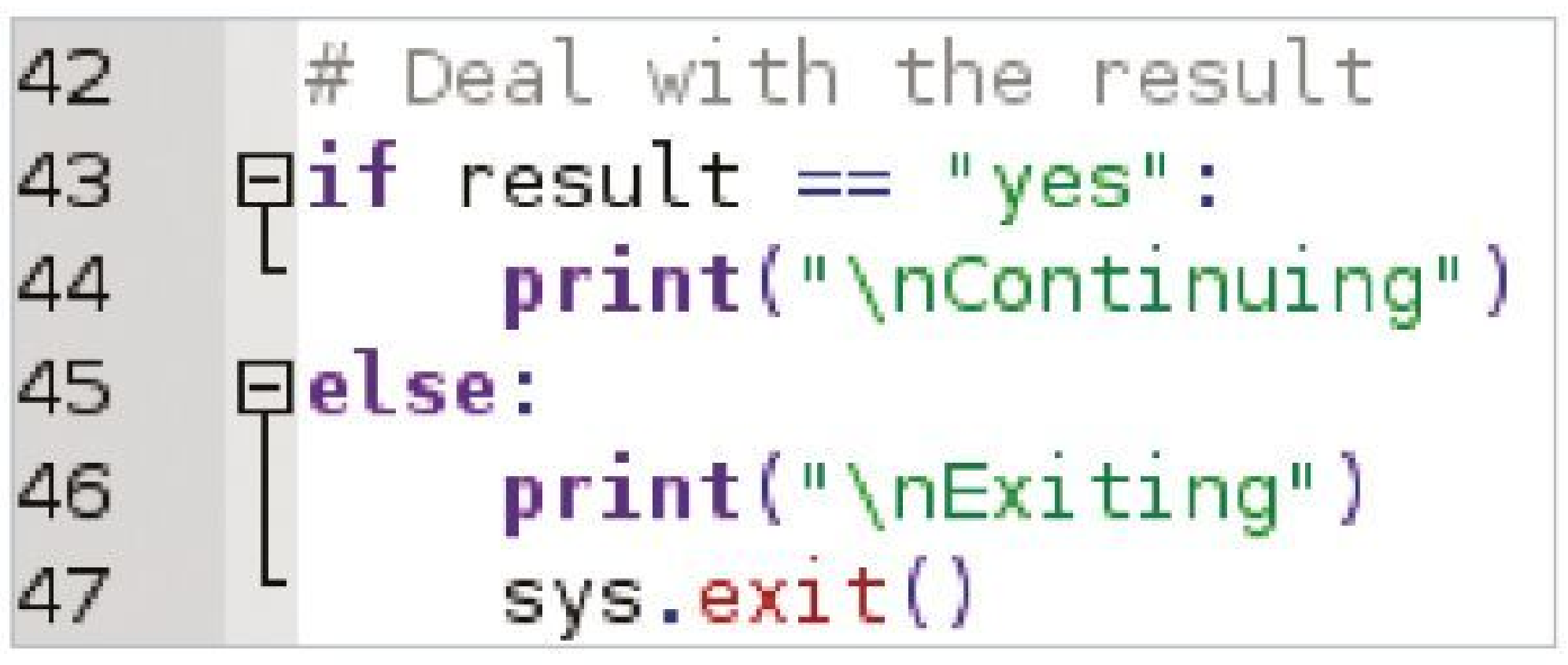


Input validation with While loops and If statements

12 To demonstrate a while loop and if statements, we will output a question to the user that requires a yes or no answer. We're going to ask them if they want to continue – and for this we require either a lower-case 'yes', or a lower-case 'no'. A while loop is a loop that runs until a condition is met. In this case, we will create a variable called yesOrNo and the while loop will run while yesOrNo is false. The yesOrNo variable will be a Boolean type that can be either True or False. The variable will be initialised with a value of False, or the while loop will not run.

A while loop has the format 'while [condition]:' – where any code that is part of the while loop needs to be indented in the lines below the colon. Any code that is not indented will not be part of the while loop. This is the same for an if statement. The condition is checked with the comparison operator '=='. A single '=' is an assignment operator whereas a double equals is a comparison operator. Another common comparison operator is '!=' – which means 'not equal to'.

We create a variable called 'result', which holds the result of the question, do you want to continue? We then check this result is valid with an if statement. Notice the 'or' operator which allows two conditions to be tested. If the user inputs a correct value then we set yesOrNo to True, which stops the while loop on the next run. Otherwise, we output an error message and the while loop will run again. The user can use the Ctrl+C command at the terminal to exit the program at any time.



```
# Deal with the result
if result == "yes":
    print("\nContinuing")
else:
    print("\nExiting")
    sys.exit()
```

Continue or exit?

13 Next we will deal with the result that was stored during the while loop with if statements. If the user typed 'yes' then we will print 'Continuing'. Otherwise, we will print 'Exiting' and then call the sys.exit function. You don't have to do anything else for the program to continue because it will simply carry on if the sys.exit function wasn't called. This code also shows that the newline character \n can be used anywhere in a string, not just in separate quotation marks like above.

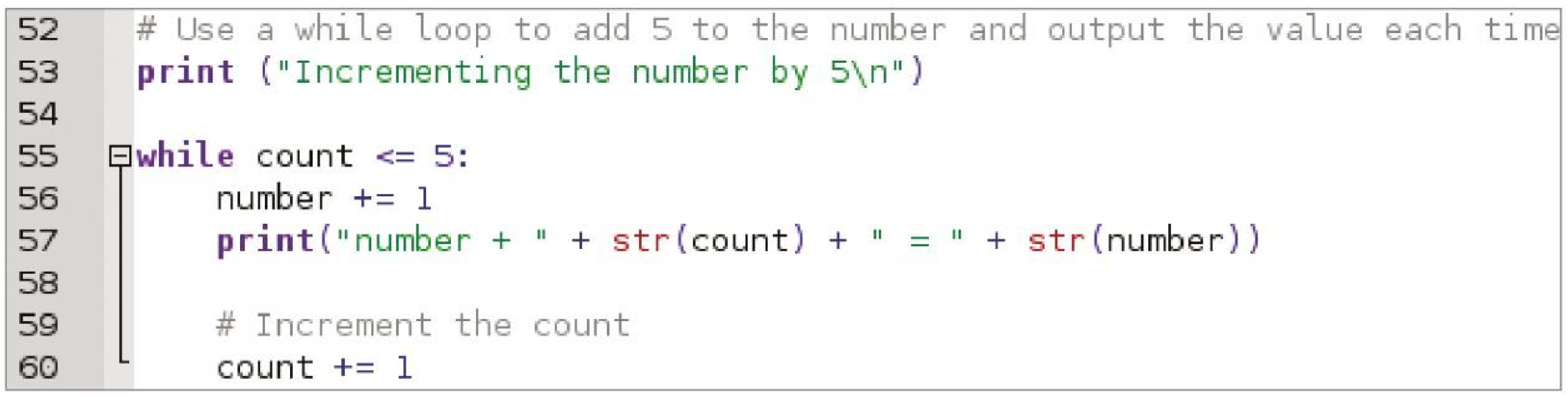
Loops with numbers

14 We'll be using a while loop that uses a number and a <= (less than or equal to) operator as its stopping condition. The while loop will be used to increment the number by 1, printing the change on each loop until the stopping condition is met. The count variable allows us to know exactly how many times we have been through the while loop.

Incrementing numbers with a loop

15 The while loop will run until the count is 6, meaning that it will run for a total of 5 times because the count begins at 1. On each run, the while loop increments the number variable and then prints what is being added to the original number, followed by the result. Finally, the count is incremented.

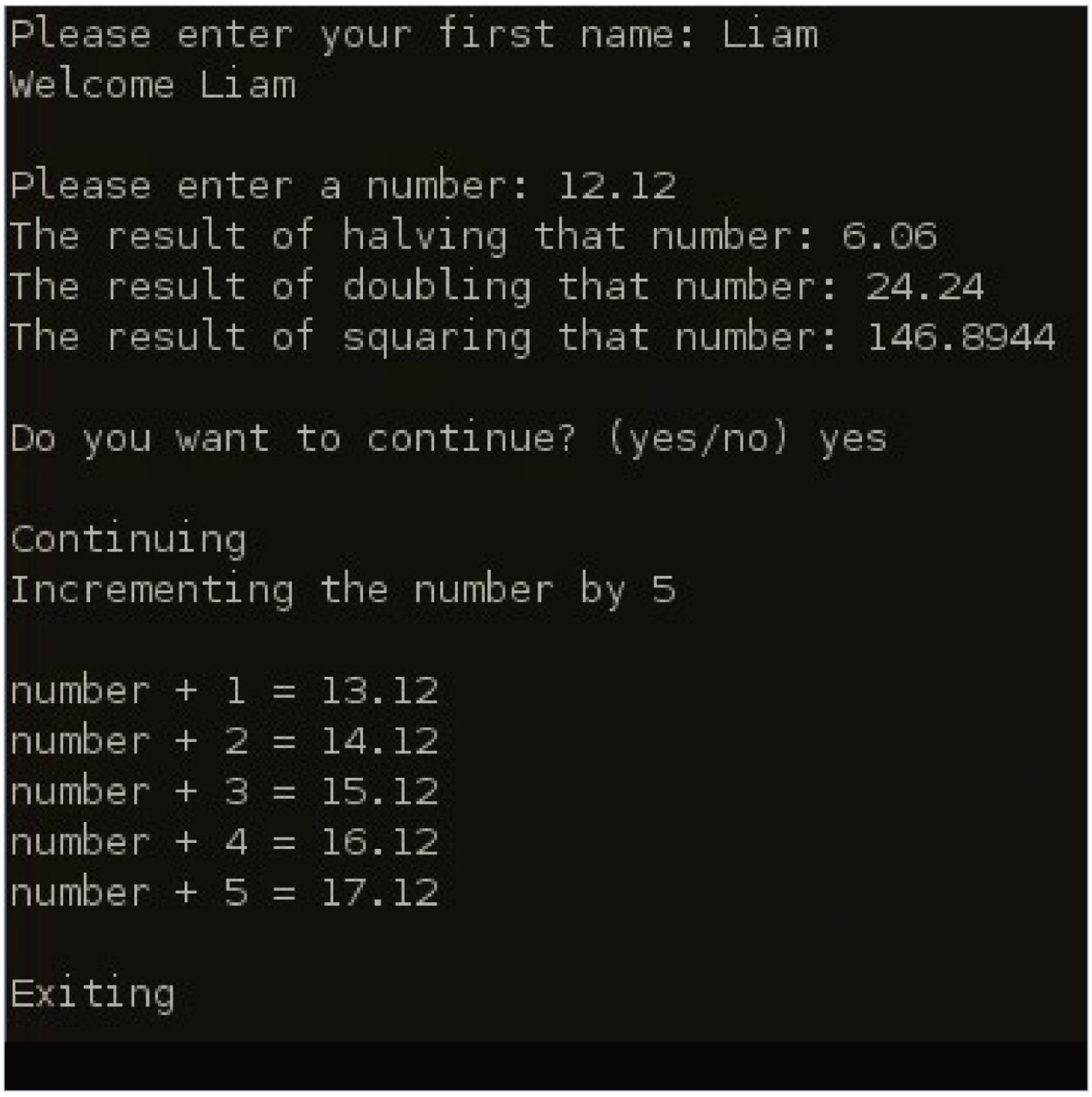
> "The print function always adds a new line at the end of its output"



```
# Use a while loop to add 5 to the number and output the value each time
print ("Incrementing the number by 5\n")

while count <= 5:
    number += 1
    print("number + " + str(count) + " = " + str(number))

    # Increment the count
    count += 1
```

Finishing off

16 The final step is to print that the program is exiting. This is the last line and we don't have to do anything else because Python simply finishes when there are no more lines to interpret.



```
Please enter your first name: Liam
Welcome Liam

Please enter a number: 12.12
The result of halving that number: 6.06
The result of doubling that number: 24.24
The result of squaring that number: 146.8944

Do you want to continue? (yes/no) yes

Continuing
Incrementing the number by 5

number + 1 = 13.12
number + 2 = 14.12
number + 3 = 15.12
number + 4 = 16.12
number + 5 = 17.12

Exiting
```

Admire your work

17 Now that we've finished coding, save any changes you have made and run your program with the F5 key.

What you'll need…

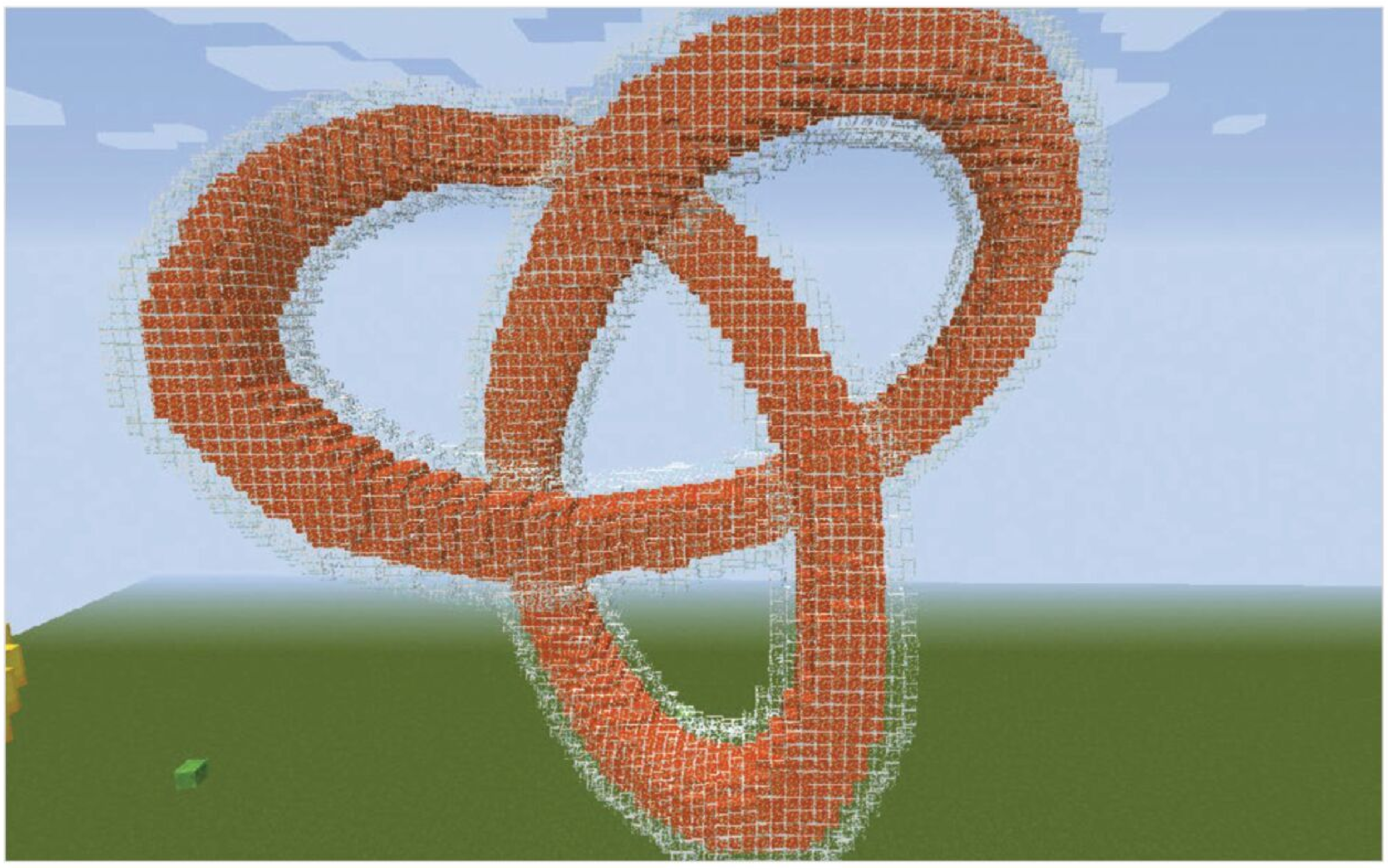
Minecraft http://www.mojang.com/games

Python https://www.python.org

McPiFoMo http://rogerthat.co.uk/McPiFoMo.rar

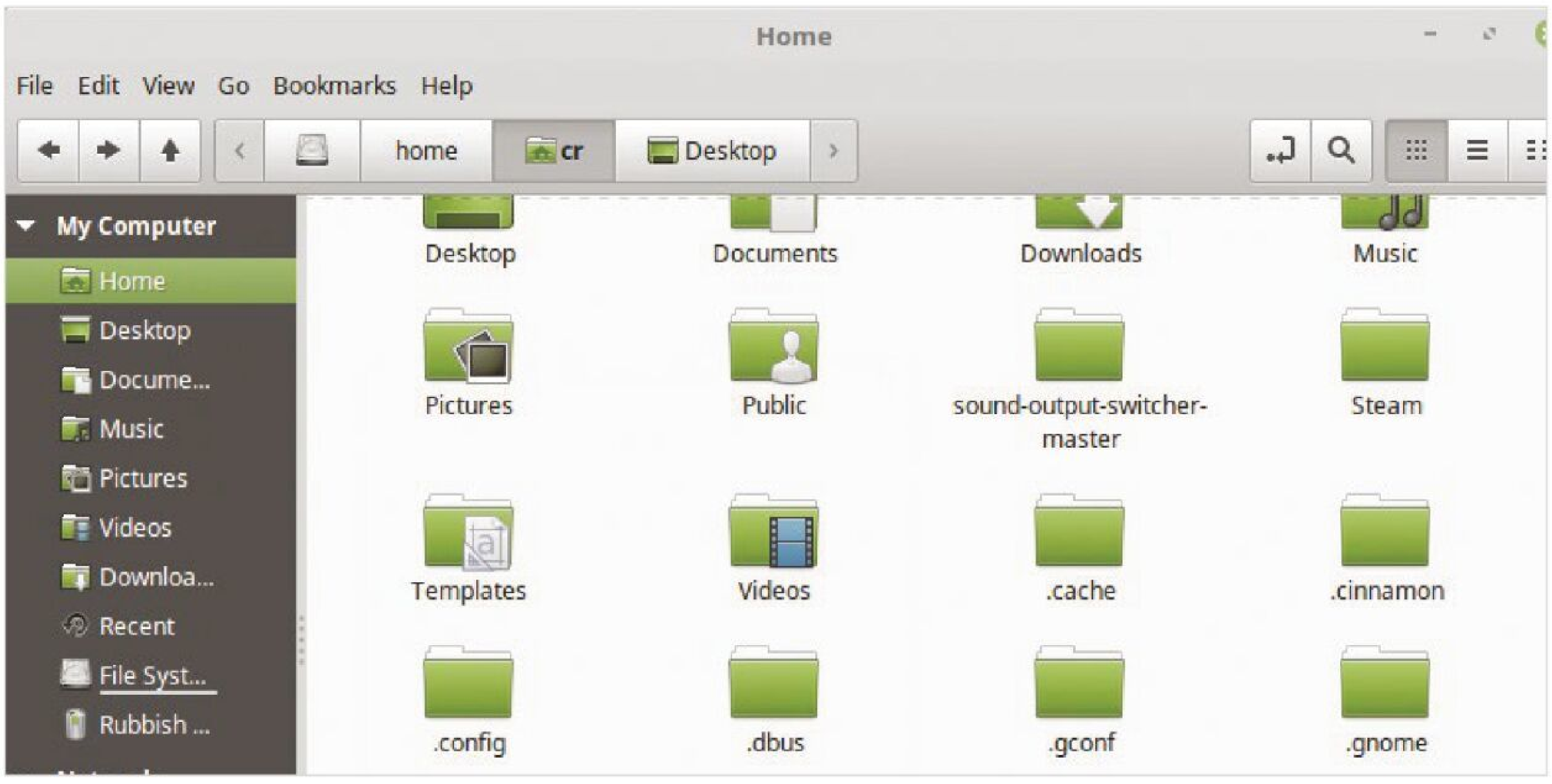
Use Python to code new creations in Minecraft

Tap directly into Minecraft with Python and produce fantastic creations using Forge mod



Sometimes, Minecraft can seem far more than just a game. It's an incredibly creative tool and with the use of Redstone and Command Blocks you can produce some amazing worlds. We're taking things a step further by enabling you to plug Python code directly into Minecraft. What you do with it is completely up to your imagination! MCPiPy was developed by 'fleap' and 'bluepillRabbit' of https://mcpipy.wordpress.com, to connect MineCraft Pi Edition with Python on the Raspberry Pi, using open APIs.

However, with the use of Forge we have put together a package that enables the use of Python in retail Minecraft. We're using Raspberry Jam developed by Alexander Pruss, a Forge mod for Minecraft which implements most of the Raspberry Juice/Pi API.


Home
File Edit View Go Bookmarks Help
home
cr
Desktop
My Computer
Home
Desktop
Docume...
Music
Pictures
Videos
Downloa...
Recent
File Syst...
Rubbish ...
Desktop
Documents
Downloads
Music
Pictures
Public
sound-output-switcher-master
Steam
Templates
Videos
.cache
.cinnamon
.config
.dbus
.gconf
.gnome

Replace your .minecraft directory

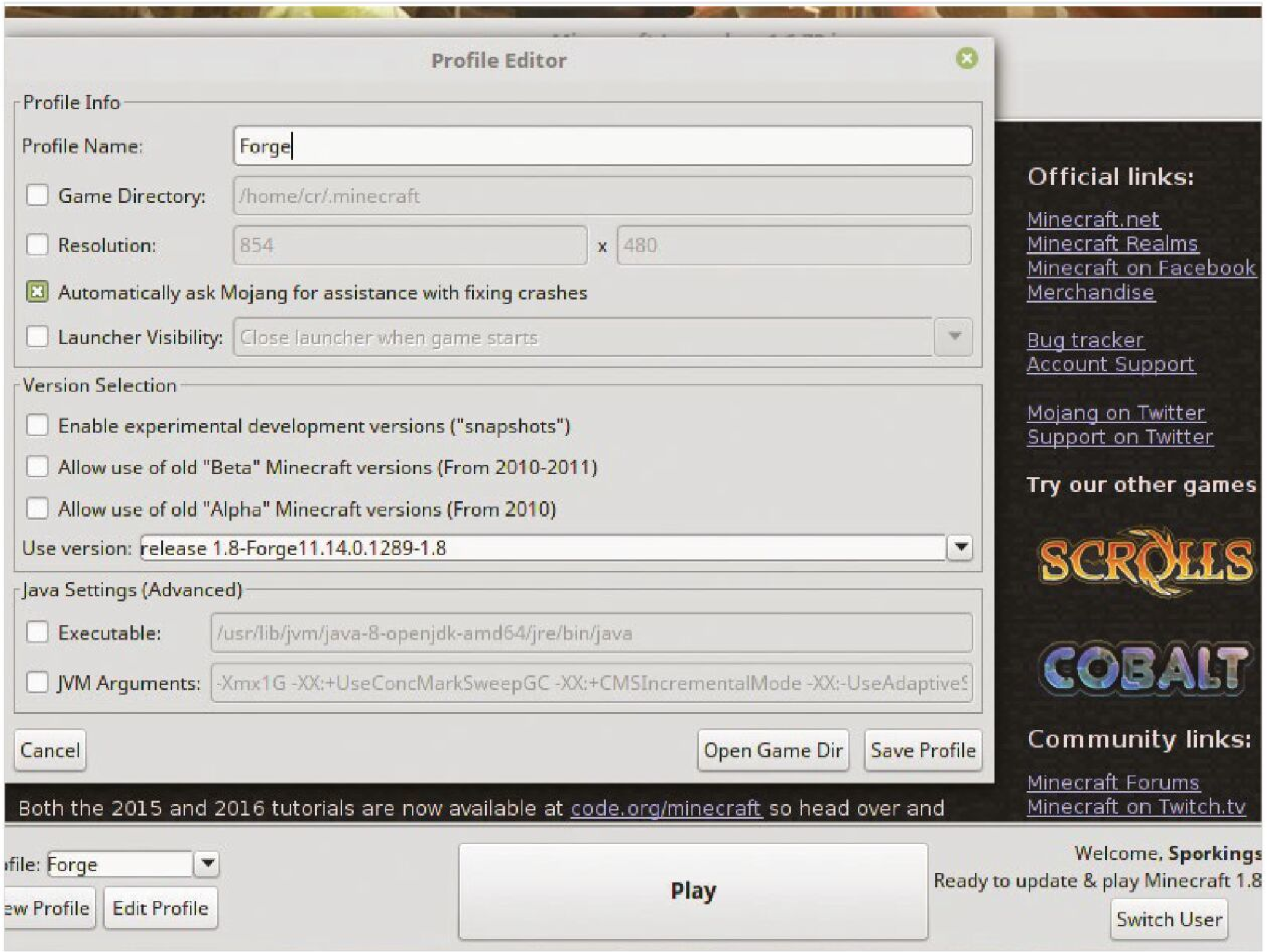
01 Backup .minecraft in your home directory. If you're using a GUI, you may need to press CTRL+H to view the hidden directories. In terminal **mv ~/.minecraft ~/minecraft-backup** should suffice.

Right Backup your original .minecraft dir and copy over the modded install from McPiFoMo

Below You'll need to run Minecraft 1.8 with the pre-installed Forge profile

Launch Minecraft in Forge mode

02 Launch Minecraft as you normally would, but after logging in, select the Forge profile. This should load Minecraft 1.8 with Forge 11.14. You can play around with the latest version of Minecraft and download and install an updated Forge if you wish, but these are the versions we've found most compatible with Raspberry Jam. You'll know you're running the correct profile when you see the version numbers in the bottom left corner of the window. Create a new super flat world in singleplayer creative mode and you're ready to begin coding.



Profile Editor

Profile Info

Profile Name: Forge

☐ Game Directory: /home/cr/.minecraft

☐ Resolution: 854 x 480

☒ Automatically ask Mojang for assistance with fixing crashes

☐ Launcher Visibility: Close launcher when game starts

Version Selection

☐ Enable experimental development versions ("snapshots")

☐ Allow use of old "Beta" Minecraft versions (From 2010-2011)

☐ Allow use of old "Alpha" Minecraft versions (From 2010)

Use version: release 1.8-Forge11.14.0.1289-1.8

Java Settings (Advanced)

☐ Executable: /usr/lib/jvm/java-8-openjdk-amd64/jre/bin/java

☐ JVM Arguments: -Xmx1G -XX:+UseConcMarkSweepGC -XX:+CMSIncrementalMode -XX:-UseAdaptive

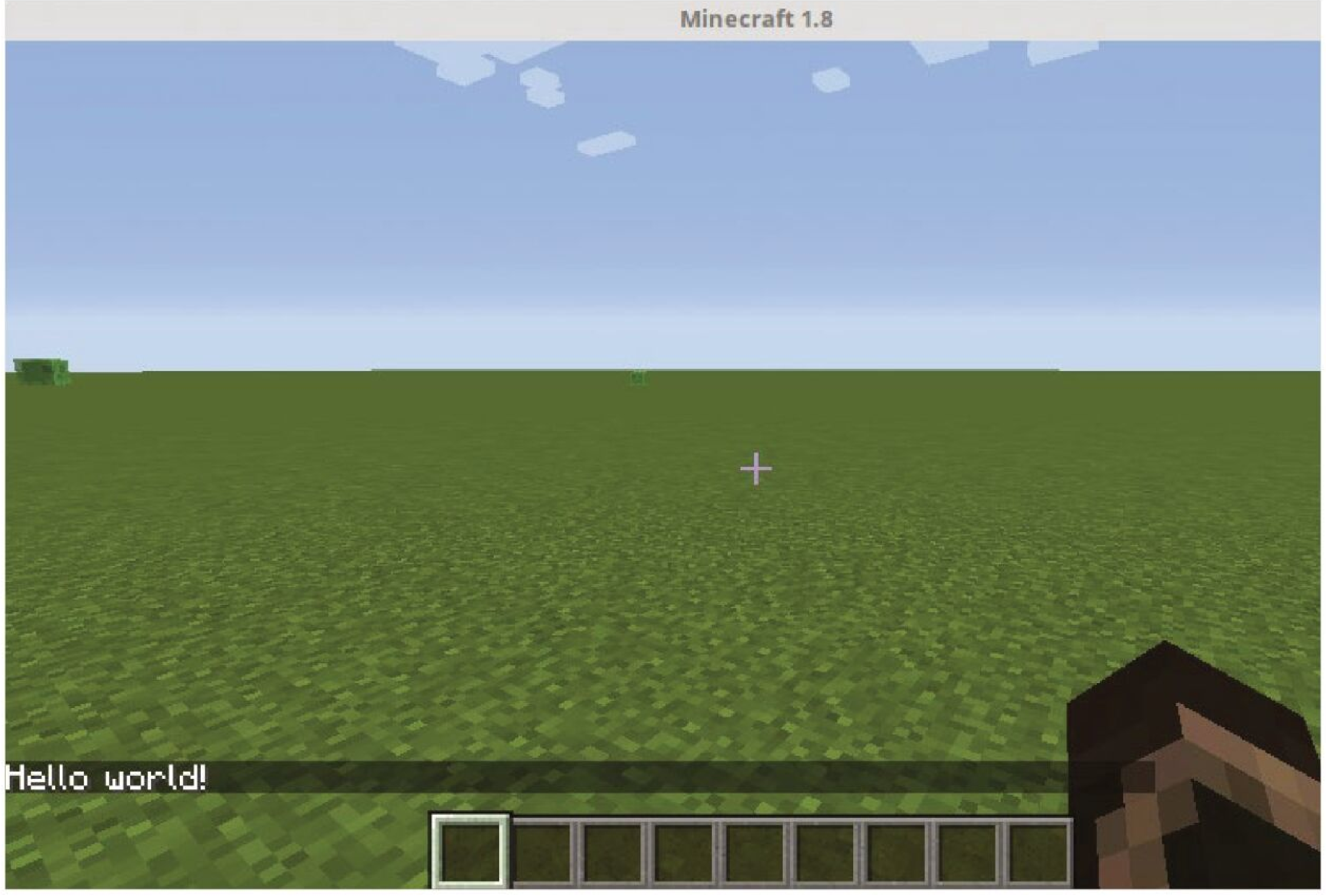
Both the 2015 and 2016 tutorials are now available at code.org/minecraft so head over and

ofile: Forge

Welcome, **Sporkings**

Ready to update & play Minecraft 1.8

Cancel
Open Game Dir
Save Profile
Official links:
Minecraft.net
Minecraft Realms
Minecraft on Facebook
Merchandise
Bug tracker
Account Support
Mojang on Twitter
Support on Twitter
Try our other games
SCROLLS
COBALT
Community links:
Minecraft Forums
Minecraft on Twitch.tv
ew Profile
Edit Profile
Play
Switch User


Minecraft 1.8

Hello world!

Hello World – Implement chat commands

03 Using your favourite text editor, you'll need to create a new **helloworld.py** file and save it in **~/.minecraft/mcpipy** directory:

```
from mc import *
mc = Minecraft()
mc.postToChat(“Hello world!”)
```

Return to Minecraft and type **/python helloworld**

Minecraft will now run your python script, which should result in a chat command saying Hello world!

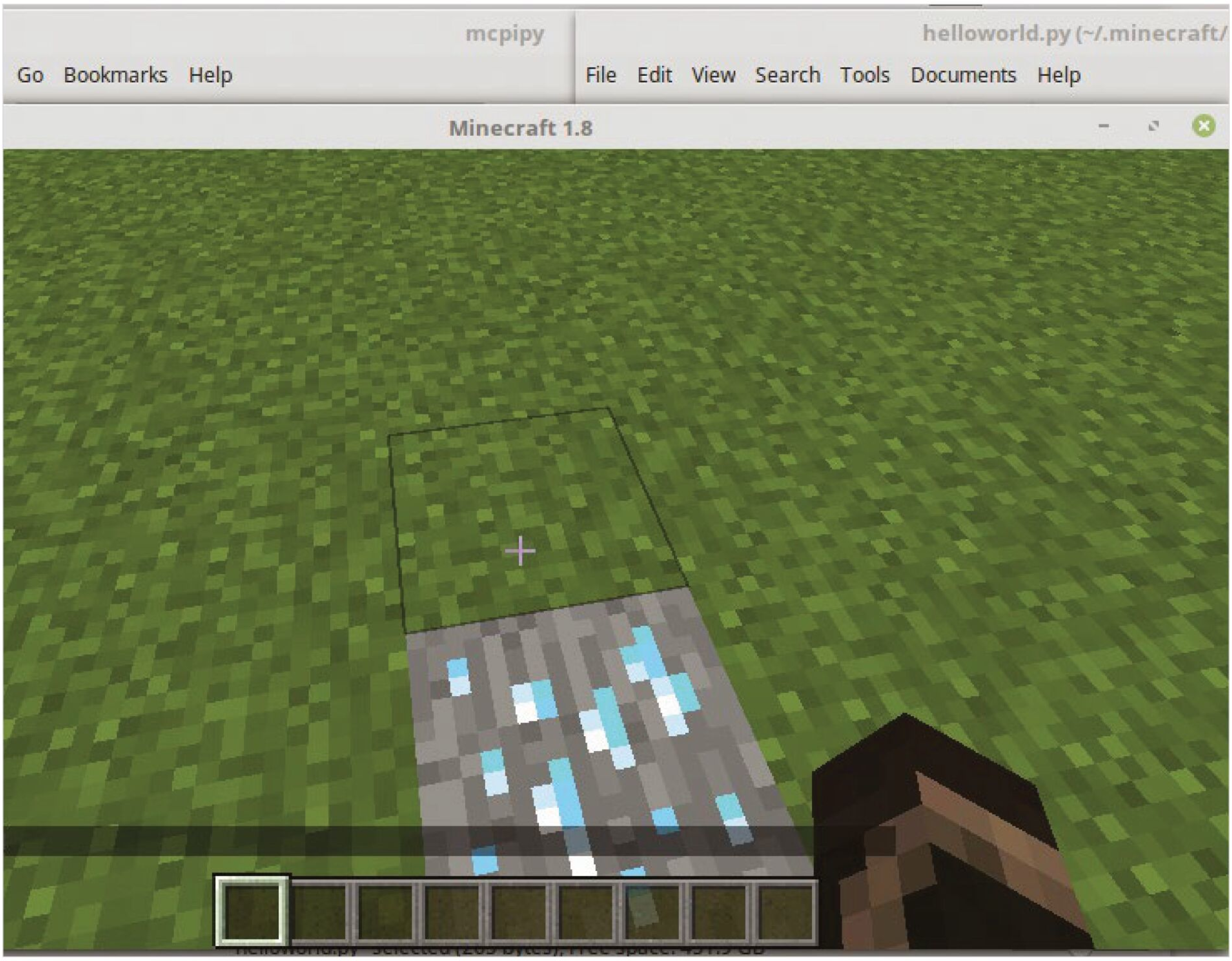
Print the total number of devices found

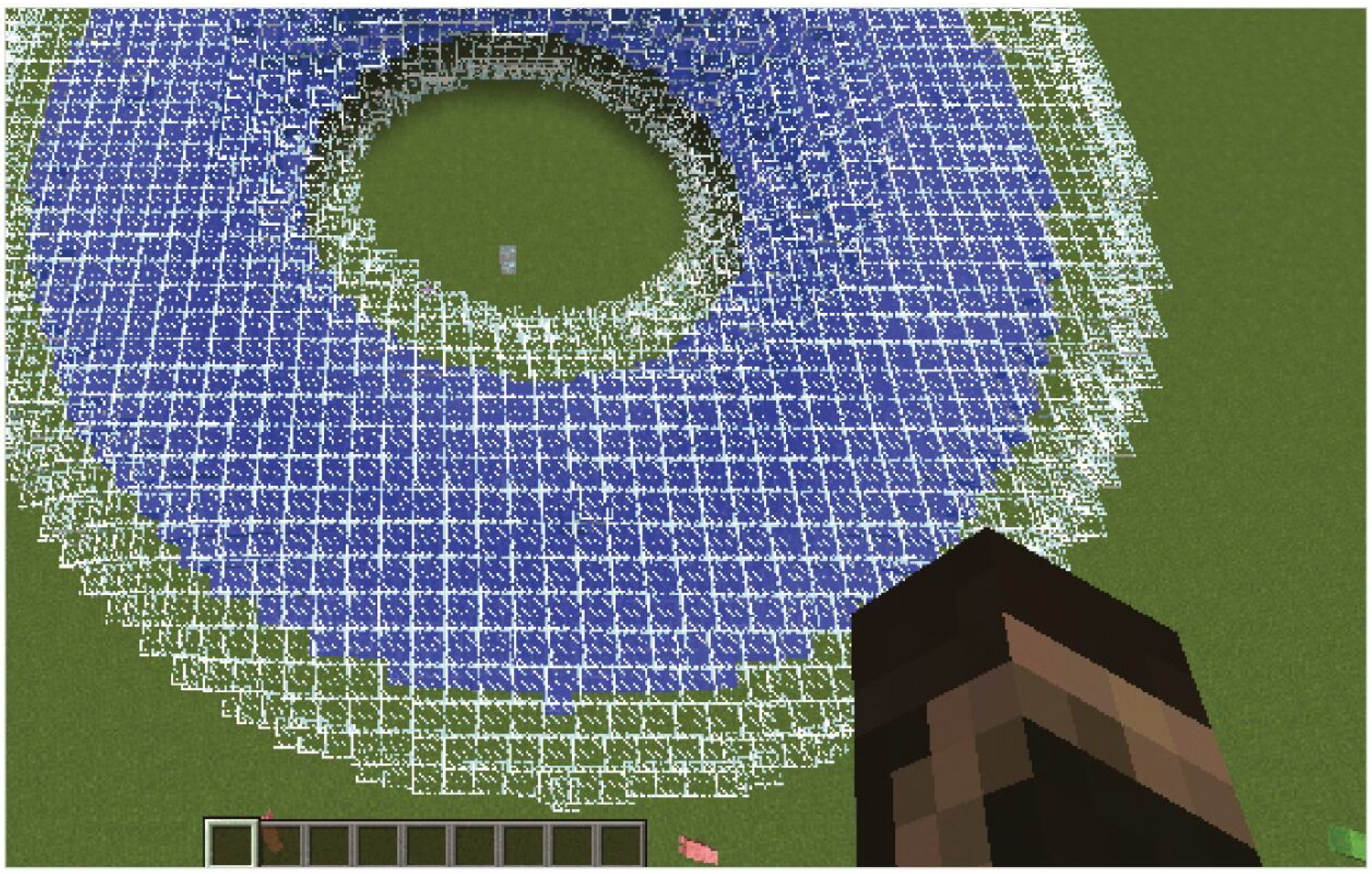
04 Now, by using **setBlock()** and **getPos()** commands we can place blocks into the world relative to our player's position. Try adding the following two lines to your **helloworld** script:

```
playerPos = mc.player.getPos()
mc.setBlock(playerPos.x,playerPos.y-1,playerPos.z,DIAMOND_ORE)
```

Then run **/python helloworld** again in Minecraft. You'll see the chat message again, but this time if you look down to the ground below your player character, you'll see a diamond block has also been placed at your feet. You can try replacing **DIAMOND_ORE** with any other Minecraft block ID (i.e. DIRT/GRASS).

"If you look down to the ground below your player character, you'll see a diamond block has been placed at your feet"


mcpipy
Go Bookmarks Help
helloworld.py (~/.minecraft/
File Edit View Search Tools Documents Help
Minecraft 1.8



Mmm, doughnuts

05 One of the pre-fab scripts that you will find in the MCPiPy collection is the doughnut:

```
from mc import *

def draw_donut(mcx,mcy,mcz,R,r,mcblock):
for x in range(-R-r,R+r):
for y in range(-R-r,R+r):
xy_dist = sqrt(x**2 + y**2)
if (xy_dist > 0):
ringx = x / xy_dist * R #  nearest point on major ring
ringy = y / xy_dist * R
ring_dist_sq = (x-ringx)**2 + (y-ringy)**2

for z in range(-R-r,R+r):
if (ring_dist_sq + z**2 <= r**2):
mc.setBlock(mcx+x, mcy+z, mcz+y, mcblock)

mc = Minecraft()

playerPos = mc.player.getPos()

draw_donut(playerPos.x, playerPos.y + 9, playerPos.z, 18, 9,
GLASS)
mc.postToChat(“Glass donut done”)
draw_donut(playerPos.x, playerPos.y + 9, playerPos.z, 18, 6,
WATER_STATIONARY)
mc.postToChat(“Water donut done”)
```

By changing the block ID from WATER_STATIONARY you can fill the doughnut with any object type. Try filling the glass with lava. Then try changing outer shell from glass to TNT.

Common errors

06 If you get a 'Script not found' error, this probably means that you don't have the mod scripts installed in your Minecraft directory. Check that you've replaced **.minecraft** with the one from McPiFoMo.

If you receive a 'Cannot run program "python"' error, your game cannot locate Python. Ensure you've got the latest version of Python installed, and that it's installed in Path. In the Bash shell type export **ATH="$PATH:/usr/local/bin/python"** to check.

Should you come into any problems with memory leakage or infinite loops, you can stop a script that's running by just typing **/python**.

Cannot find script

If you see red text stating 'Cannot find script', check the name and location of your PY file. All of your Python scripts should be in **~/.minecraft/mcpipy**, for Python and Minecraft to be able to locate them. You don't need to append '.py' to the end of your run command, just be sure you're using the exact name of your Python script file. **/python doughnut** will work just as well as **/python doughnut.py**, so long as **doughnut.py** is stored in **~/.minecraft/mcpipy**. If you can't see this directory, remember to un-hide your files (CTRL+H).

Handle multiple tasks

Your Pi project may need to deal with more than one thing at a time. Learn how to handle multiple tasks

In this tutorial, we will look at how to use the multitasking capabilities within Python to manage multiple tasks. In the standard library, there are three main modules that are available. They are threading, multiprocessing and concurrent. Each has its own strengths and weaknesses. Since these are all part of the standard library, there should not be anything extra that you will need to install.

First, we will look at the threading module. There are two ways that you can use this module. The first is to use it to create new thread objects that can be told to run some target function within your program. The following is a simple example:

```
import threading
def my_func():
       print(“Hello World”)
my_thread = threading.Thread(target=my_func)
my_thread.start()
```

Assuming that your tasks can be partitioned into separate functions, you can create a thread for each of these functions. One thing to be aware of is that these new threads will not start executing the function code until you call the start method. At that point, the target function will start running asynchronously in the background. You can check to see whether or not a given thread is done by using code like that below:

```
if my_thread.is_alive():
print(‘This thread is still running’)
```

At some point in the main body of your program, you are going to want to use the results from the functions running in these threads. When this happens you can use the join() method of the thread object. This halts the main core of your program and forces it to wait until the thread exits. The thread exits by default when the running function exits.

But, how do you write code that uses threads well? The first item to consider is whether you will be using data that is globally available or whether you are using data that should only be visible within the current thread. If you do need local only data, you can create a local object that can store these values. The following code stores a string with your author's name in it:

```
mydata = threading.local()
mydata.myname = 'Joey Bernard'
```

This would be code used within the function being run by a thread. If you need to use global data, you need to consider how different threads may try to use this global data. If everyone is reading from a given variable, you won't run into any issues. The problem arises when you have multiple threads that may try to write a given variable. In this case you'll end up with a situation known as a race condition, where one thread may overwrite the data from another. In these cases, you will need to use lock objects to manage access to these global variables. A basic example would look like:

```
mylock = threading.Lock()
counter = 0
def func1():
        mylock.acquire()
        counter = counter + 1
        mylock.release()
```

As you can see, you create the lock object in the main body of your program. Then, within the function code, you try to acquire the lock. If it is free, you get access to it and it is locked. If the lock object has already been locked by another thread, then this call to acquire blocks and waits until the lock has been released. This is why you need to be really careful to always have a release statement for every acquire statement. Otherwise, you'll have a bug that will be almost impossible to find after the fact. This also introduces a bottleneck to your program, so you want to make sure that whatever code exists between the acquire and lock is the bare minimum required to do the necessary work. This is the simplest form of locking mechanism available in Python. If your needs are greater, you can look at some of the other options to see if they might offer better control access. Along with controlling access to global data, you may need to communicate directly between threads. This can be handled through an event object, which can be used to set a flag to true or false and make that visible to other threads. As an example, the code below shows how to set and use such a flag:

```
event1 = threading.Event()
def func1():
      ....
     event1.set()
    ....
def func2():
    ....
      if event1.set():
      print('I got a flag from func1')
    ....
```

Sometimes, the only communication you need is to know when all of the threads have completed some stage of their work. Say, you multiple threads loading data files and you need to wait until everyone is done before moving on to the next stage. In this case, you can do so with barrier objects. Below, you can see how you could add a barrier to the two threads (above):

```
barrier1 = threading.Barrier(2)
def func1():
    ....
    barrier1.wait()
    ....
def func2():
    ....
    barrier1.wait()
    ....
```

In the above code, you need to set how many threads will take part in the barrier object when you create it. Then, when threads use it and call the wait method, they will block until all of the threads call the wait method. The threading module is a light, fast and easy method to add the ability divide up the processing within your code, but it does suffer from one major issue. Within the Python core engine, there is a structure called the GIL (global interpreter lock). The GIL is used to control access to certain core functions and data within the Python interpreter. This means that at certain points, your threads will run only one at a time. This can introduce a serious bottleneck in some situations. If you are in this boat, then you may need to use the multiprocessing module. This module uses subprocesses to bypass the GIL completely in order to get true parallel operation. In its most basic use case, you could use something like the code below to get behaviour similar to what you get with threads:

```
import multiprocessing
def f(name):
     print(‘hello’, name)

p = multiprocessing.Process(target=f,
args=(‘bob’,))
p.start()
p.join()
```

This appears to be the same on the surface, but what is happening in the back-end is radically different. The process object starts up a new Python engine in one of a number of ways. The default on UNIX systems, like the Pi, is to fork a new process. The fork method essentially makes a complete copy of the current Python engine and executes the given function. Another method is to spawn a new Python engine. In the spawn method, only the parts of the current Python engine that is needed for the new Python engine. If you do need to change it, you can use the following code:

```
multiprocessing.set_start_
 method(‘spawn’)
```

If you need to start many subprocesses, this may help speed your code up. The set_start_method should only ever be called once in a given program. Hopefully, this tutorial has given you some ideas on how to include the ability to manage multiple tasks in parallel. This can be a powerful tool to make the software design of your project more flexible and capable. Be aware that we have only been able to cover the most basic topics in such a short tutorial.

Other ways to do parallelisation

We've looked at how to handle parallel tasks strictly within a Python program. But sometimes you need to run other pieces of code asynchronously. In these cases, you can use the subprocess module to execute external code and interact with it. As an example, we will look at how you could run the ls program and use its output.

```
import subprocess
subprocess.run([“ls”, “–l”],
 stdout=subprocess.PIPE)
```

The run method accepts as input the external program to be run, along with any parameters. By default, run doesn't send the output from the external program back in to the main Python code. In this example, we set the input parameter stdout to be the PIPE value, so the output from the external program is sent back to the calling Python code. Sometimes, you may want to run this external program through a shell. In order to do this, you will need to use the input parameter shell=True.

The run method is a simplified interface for running external programs. When you need more control over how the external programs execute, you can use the Popen method.

```
proc1 = subprocess.Popen([‘/bin/
 ls’, ‘–l’])
```

To communicate with this external process, you can use the communicate method. You can get both the stdout and stderr streams with the following code:

```
outstream, errstream = proc1.
    communicate()
```

If you want to also send input to the external process, you can include a parameter named input with the data. This blocks until the external process finishes and exits. If you need to read from these streams without waiting for the external program to finish, you can get access to pipes for stdout and stderr streams. For example, the following code reads from the standard output stream:

```
proc2 = subprocess.Popen([‘ls’,
 ‘–l’], stdout=subprocess.PIPE)
proc2_output = proc2.stdout
print(proc2_output.read())
```

If you need to, you can akways explicitly stop the external process using terminate() or kill() methods.

What you'll need…

- **Raspberry Pi 3**
- **8GB SD card**
- **Xbox 360 controller**
- **Oculus Rift Developer Kit** (optional)

Create a Pi-powered virtual reality setup

Combine the Raspberry Pi, Python-VRZero and 3D graphics module Pi3D to edit or make virtual reality environments

Virtual Reality is huge now and has come a long way since the concepts and CGI visuals of Stephen King's *Lawnmower Man*. It is one of the fastest growing areas of technology and you can now design models, explore new places and play games all within a virtual environment.

A professional VR hardware package is expensive and will set you back several hundred pounds. However, it's possible to emulate the VR setup up using a Raspberry Pi, Python-VRZero and a 3D graphics module, Pi3D. Now, this is purely for fun and learning, so don't expect huge gaming PC frame rates, although some of the demos do peak at around 25-30 FPS on a Raspberry Pi 3. This tutorial shows you how you create a VR setup using the Raspberry Pi 3, a Xbox 360 controller and some Python code. Our first steps will walk you through how to install the required software and modules. We'll then cover configuring the hardware and drivers to enable you to control movement within the VR environment. The final steps look at the program code structure, where you can develop your own versions of the VR demo or design and build your own virtual worlds.

Python-VRZero

01 Using Python-VRZero is a frictionless way to get started creating your own virtual reality worlds in Python on a Raspberry Pi and combine an Oculus Rift. The program adds a number of features on top of Pi3D and solves the headaches of configuring a Pi 3 for VR development in Python. It includes default input event handling for keyboard, mouse, controller and the Rift for moving and altering the view of the player. It also supports Xbox 360 controller configuration and uses OpenHMD to read the rotational sensor reading from the Rift.

Fresh SD card install

02 Before you get started, it is recommended that you use a new SD card with a freshly installed image of the Raspberry Pi's official operating system, Raspbian. You can download the operating system directly from the Raspberry Pi website at **https://www.raspberrypi.org/downloads**. Install using your normal preferred method. This project setup was tested using the Pixel OS image.

Update the Pi

03 Boot up your Raspberry Pi. At this stage you do not need to connect the Xbox 360 controller or Oculus Rift. When loaded, open the LXTerminal and update and upgrade the OS typing the two lines below. This may take some time.

```
sudo apt-get update
sudo apt-get upgrade
```

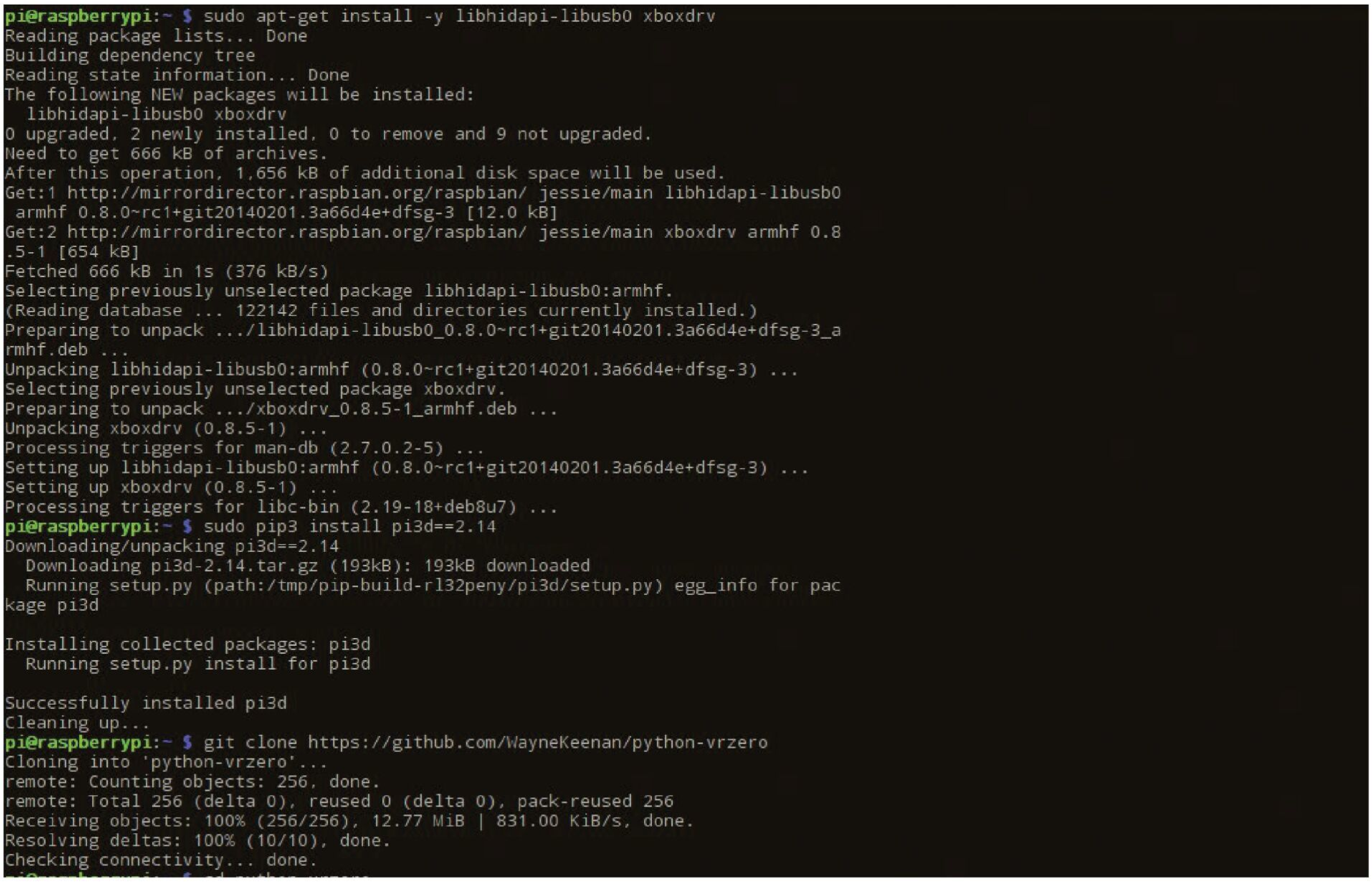
Install the Xbox 360 controller drivers

04 Now install the package dependencies for the Xbox 360 controller. You can keep the library up to date by adding the code --upgrade to the end of the first line. Then install Pi3D software which will render the images. Type the two lines below as shown and press Enter.

```
sudo apt-get install -y
libhidapi-libusb0 xboxdrv
sudo pip3 install pi3d==2.14
```

Keep up to date

Python-VRzero is an ongoing development, and updates and improvement are always being added. Refer to the GitHub repository for the latest updates: https://github.com/WayneKeenan/python-vrzero



```
pi@raspberrypi:~ $ sudo apt-get install -y libhidapi-libusb0 xboxdrv
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following NEW packages will be installed:
  libhidapi-libusb0 xboxdrv
0 upgraded, 2 newly installed, 0 to remove and 9 not upgraded.
Need to get 666 kB of archives.
After this operation, 1,656 kB of additional disk space will be used.
Get:1 http://mirrordirector.raspbian.org/raspbian/ jessie/main libhidapi-libusb0
 armhf 0.8.0~rc1+git20140201.3a66d4e+dfsg-3 [12.0 kB]
Get:2 http://mirrordirector.raspbian.org/raspbian/ jessie/main xboxdrv armhf 0.8
.5-1 [654 kB]
Fetched 666 kB in 1s (376 kB/s)
Selecting previously unselected package libhidapi-libusb0:armhf.
(Reading database ... 122142 files and directories currently installed.)
Preparing to unpack .../libhidapi-libusb0_0.8.0~rc1+git20140201.3a66d4e+dfsg-3_a
rmhf.deb ...
Unpacking libhidapi-libusb0:armhf (0.8.0~rc1+git20140201.3a66d4e+dfsg-3) ...
Selecting previously unselected package xboxdrv.
Preparing to unpack .../xboxdrv_0.8.5-1_armhf.deb ...
Unpacking xboxdrv (0.8.5-1) ...
Processing triggers for man-db (2.7.0.2-5) ...
Setting up libhidapi-libusb0:armhf (0.8.0~rc1+git20140201.3a66d4e+dfsg-3) ...
Setting up xboxdrv (0.8.5-1) ...
Processing triggers for libc-bin (2.19-18+deb8u7) ...
pi@raspberrypi:~ $ sudo pip3 install pi3d==2.14
Downloading/unpacking pi3d==2.14
  Downloading pi3d-2.14.tar.gz (193kB): 193kB downloaded
  Running setup.py (path:/tmp/pip-build-rl32peny/pi3d/setup.py) egg_info for pac
kage pi3d

Installing collected packages: pi3d
  Running setup.py install for pi3d

Successfully installed pi3d
Cleaning up...
pi@raspberrypi:~ $ git clone https://github.com/WayneKeenan/python-vrzero
Cloning into 'python-vrzero'...
remote: Counting objects: 256, done.
remote: Total 256 (delta 0), reused 0 (delta 0), pack-reused 256
Receiving objects: 100% (256/256), 12.77 MiB | 831.00 KiB/s, done.
Resolving deltas: 100% (10/10), done.
Checking connectivity... done.
```

Install software – part 1

05 The Python-VRzero is available from the GitHub website and is easy downloaded using the git clone command, line one. Type this into your LXTerminal. Then move to the **python-vrzero** folder (line two) and install the program (line three).

```
sudo git clone https://github.com/WayneKeenan/python-vrzero
cd python-vrzero
sudo python3 setup.py install
```

Install software – part 2

06 Once the installation completes, select and install the OpenHMD (line one) which enables the data from the Oculus Rift sensors to be read and worked with. Type line one into the LXTerminal and press Enter, then line two to install the required module. Enter line three and press Enter to link together all the required libraries:

```
sudo dpkg -i install/openhmd_0.0.1-1_armhf.deb
sudo apt-get install -f
sudo ldconfig
```

Copy over the configuration files – part 1

07 To interact with the Oculus Rift's rotation sensor and the Xbox 360 controller, you'll need to copy over the configuration files. This enables you to orientate and look around the environments. As you turn your head to the left the VR environment will adjust as if you are looking to the left. Type both of the lines below into the LXTerminal and press Enter after each line:

```
sudo cp config/83-hmd.rules /etc/udev/rules.d/
sudo cp config/xboxdrv.init /etc/init.d/xboxdrv
```

Copy over the configuration files – part 2

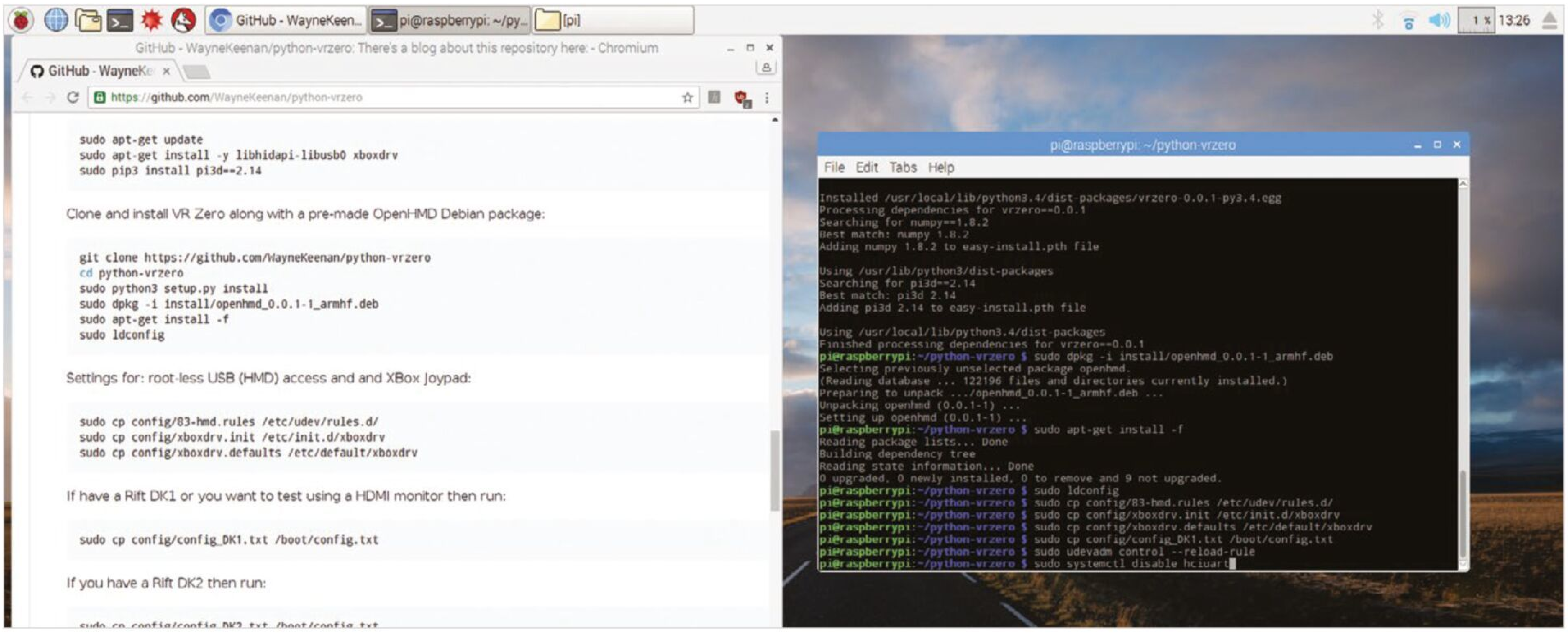
08 The Xbox 360 controller setup requires an additional command line to copy the default configuration file to the folder which contains the Xbox Drivers. This file contains all the mapping for the buttons, paddles and joysticks. Type in the line as shown below and press Enter:

```
sudo cp config/83-hmd.rules /etc/udev/rules.d/
sudo cp config/xboxdrv.init /etc/init.d/xboxdrv
```

Rift Development Kit 1

09 If you do not have an Oculus Rift kit you can still use a HDMI monitor to display the output. Move to **Step 11**. If you own or have access to the Oculus Rift Development kit, you will need to copy over the configuration file into the **config.txt** file. This file contains the configuration settings for the operating system which are loaded when you Raspberry Pi boots up. Type the line below into the LXTerminal and press Enter.

```
sudo cp config/config_DK1.txt /boot/config.txt
```


GitHub - WayneKeen...
pi@raspberrypi: ~/py...
[pi]
GitHub - WayneKeenan/python-vrzero: There's a blog about this repository here: - Chromium
GitHub - WayneKe
https://github.com/WayneKeenan/python-vrzero
pi@raspberrypi: ~/python-vrzero
File
Edit
Tabs
Help
13:26

```
sudo apt-get update
sudo apt-get install -y libhidapi-libusb0 xboxdrv
sudo pip3 install pi3d==2.14
```

Clone and install VR Zero along with a pre-made OpenHMD Debian package:

```
git clone https://github.com/WayneKeenan/python-vrzero
cd python-vrzero
sudo python3 setup.py install
sudo dpkg -i install/openhmd_0.0.1-1_armhf.deb
sudo apt-get install -f
sudo ldconfig
```

Settings for: root-less USB (HMD) access and and XBox Joypad:

```
sudo cp config/83-hmd.rules /etc/udev/rules.d/
sudo cp config/xboxdrv.init /etc/init.d/xboxdrv
sudo cp config/xboxdrv.defaults /etc/default/xboxdrv
```

If have a Rift DK1 or you want to test using a HDMI monitor then run:

```
sudo cp config/config_DK1.txt /boot/config.txt
```

If you have a Rift DK2 then run:

```
Installed /usr/local/lib/python3.4/dist-packages/vrzero-0.0.1-py3.4.egg
Processing dependencies for vrzero==0.0.1
Searching for numpy==1.8.2
Best match: numpy 1.8.2
Adding numpy 1.8.2 to easy-install.pth file

Using /usr/lib/python3/dist-packages
Searching for pi3d==2.14
Best match: pi3d 2.14
Adding pi3d 2.14 to easy-install.pth file

Using /usr/local/lib/python3.4/dist-packages
Finished processing dependencies for vrzero==0.0.1
pi@raspberrypi:~/python-vrzero $ sudo dpkg -i install/openhmd_0.0.1-1_armhf.deb
Selecting previously unselected package openhmd.
(Reading database ... 122196 files and directories currently installed.)
Preparing to unpack .../openhmd_0.0.1-1_armhf.deb ...
Unpacking openhmd (0.0.1-1) ...
Setting up openhmd (0.0.1-1) ...
pi@raspberrypi:~/python-vrzero $ sudo apt-get install -f
Reading package lists... Done
Building dependency tree
Reading state information... Done
0 upgraded, 0 newly installed, 0 to remove and 9 not upgraded.
pi@raspberrypi:~/python-vrzero $ sudo ldconfig
pi@raspberrypi:~/python-vrzero $ sudo cp config/83-hmd.rules /etc/udev/rules.d/
pi@raspberrypi:~/python-vrzero $ sudo cp config/xboxdrv.init /etc/init.d/xboxdrv
pi@raspberrypi:~/python-vrzero $ sudo cp config/xboxdrv.defaults /etc/default/xboxdrv
pi@raspberrypi:~/python-vrzero $ sudo cp config/config_DK1.txt /boot/config.txt
pi@raspberrypi:~/python-vrzero $ sudo udevadm control --reload-rule
pi@raspberrypi:~/python-vrzero $ sudo systemctl disable hciuart
```

Rift Development Kit 2

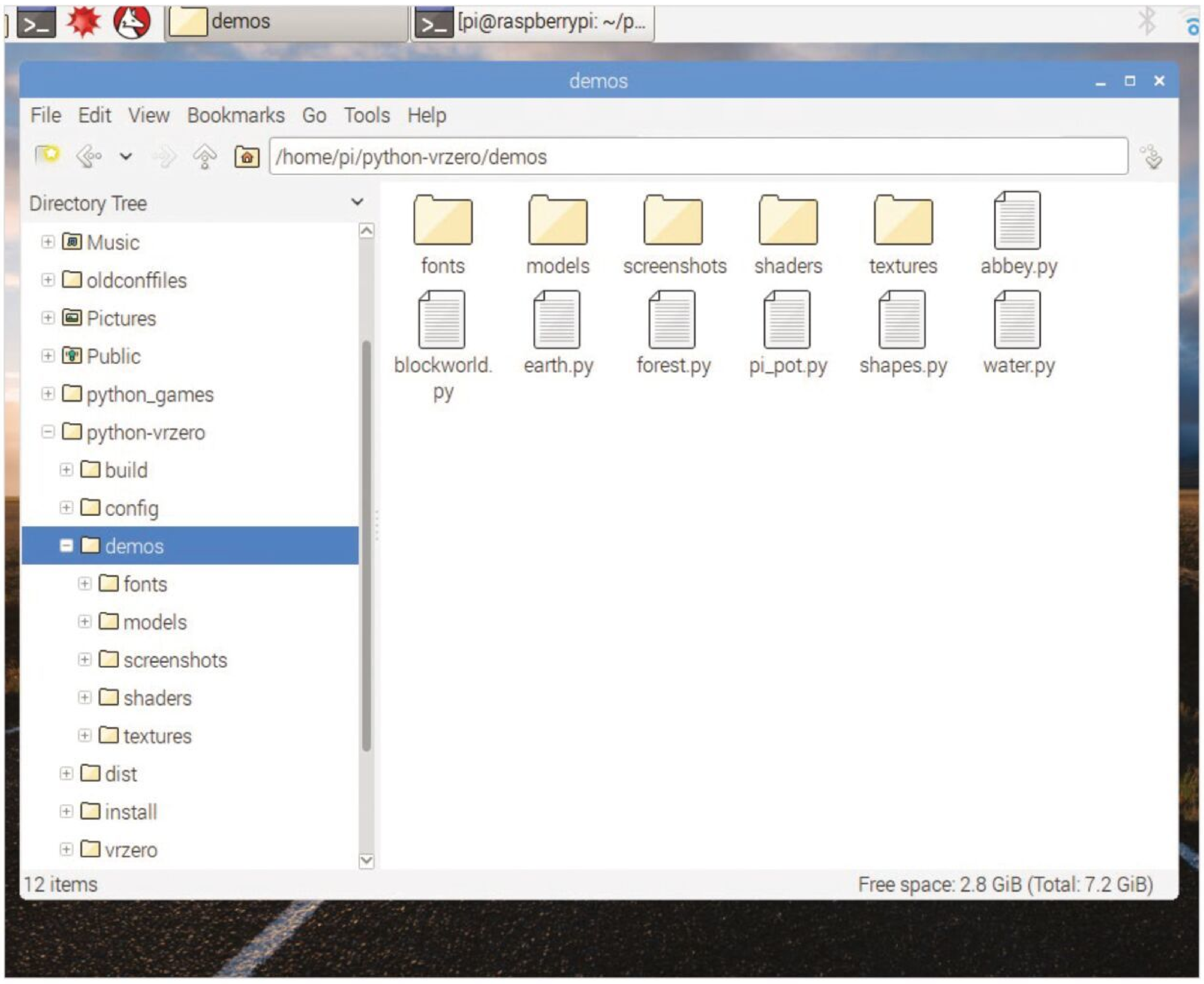
10 If you have access the Oculus Rift development kit version 2, then you will again be required to copy over a configuration file. Except this time select the config_DK2.txt file and copy the contents to the boot/config file. In the LXTerminal type the line below and press enter. Ensure that you select the correct configuration for the kit version which you have.

```
sudo cp config/config_DK2.txt /boot/config.txt
```

Complete the set up

11 Finally run two commands. The first command (line one) enables the root-less USB udev config setup which was set up earlier in **Step 7**. The second command (line two) disables BluetoothLE. This is required as it stops the OpenGL ES, from hanging. Ensure that each line is typed in as printed, and press Enter after each line to enable the command to run:

```
sudo udevadm control --reload-rules
sudo systemctl disable hciuart
```


demos
[pi@raspberrypi: ~/p...
File Edit View Bookmarks Go Tools Help
/home/pi/python-vrzero/demos
Directory Tree
Music
oldconffiles
Pictures
Public
python_games
python-vrzero
build
config
demos
fonts
models
screenshots
shaders
textures
dist
install
vrzero
fonts
models
screenshots
shaders
textures
abbey.py
blockworld.py
earth.py
forest.py
pi_pot.py
shapes.py
water.py
12 items
Free space: 2.8 GiB (Total: 7.2 GiB)

Restart and plug in

12 This completes the installation and project setup. From the LXTerminal, shutdown the Raspberry Pi (line one). Attach the Xbox 360 controller and if you have one, the Oculus Rift. Turn the Rift on first before starting the Pi to ensure that it registers the hardware when the Pi boots up:

```
sudo shutdown
```

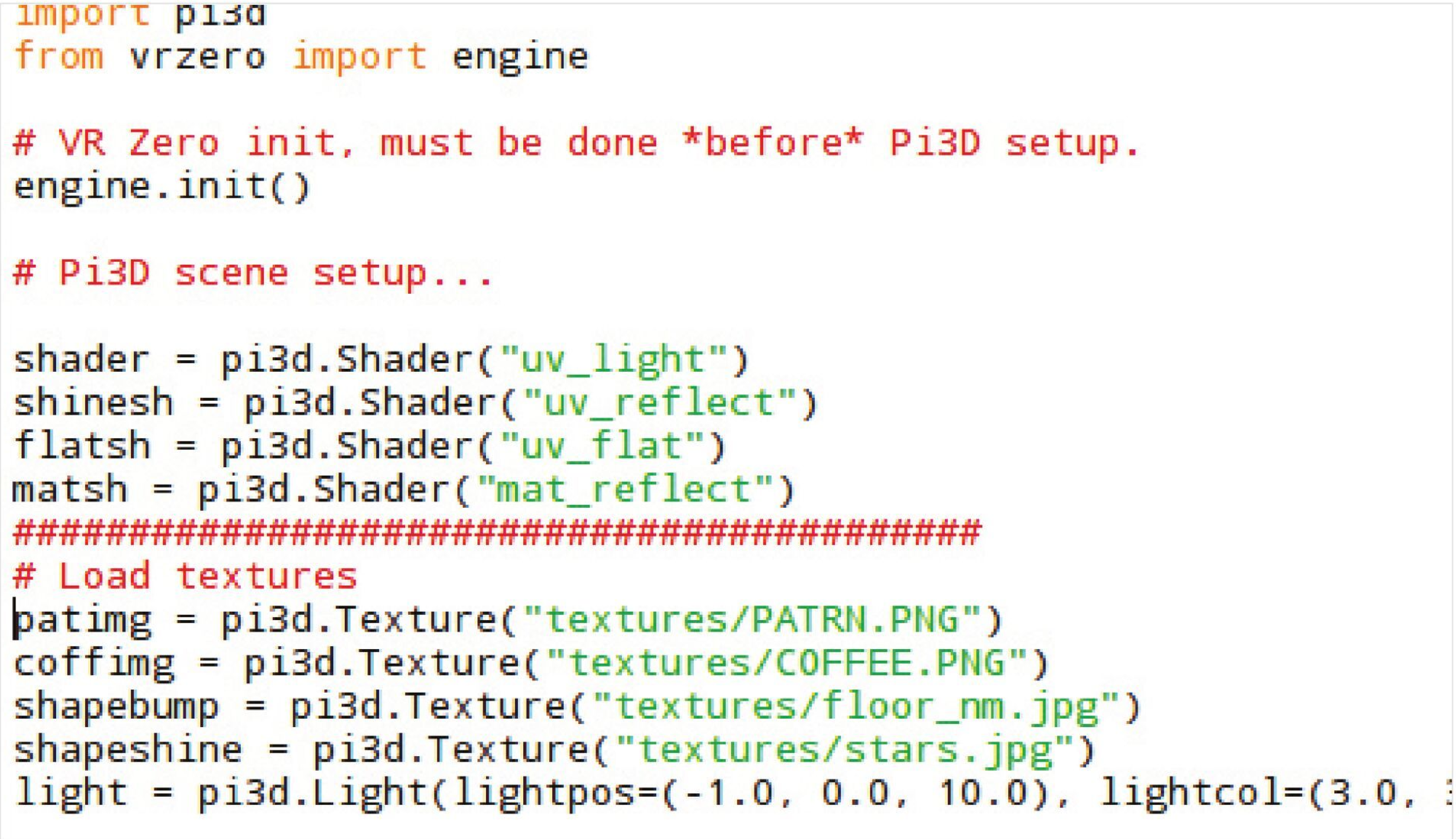
Hardware controls and setup

13 Python-VRzero sets up sensible defaults for handling input events from attached devices. The keyboard controls movement and the default mappings are: WSAD, SPACE for jump and ENTER for action. The mouse controls looking (and direction of travel when moving). Mouse button 1 is action and mouse button 2 is jump. An Xbox 360 controller controls movement and view using the left and right stick respectively. The 'A' button is 'action' and the 'B' button is jump. The OpenHMD library is used to read the HMD sensor data. VR Zero automatically rotates the Pi3D Steroscopic camera in response to HMD readings.

Running a demo

14 Now for the fun part, which is to run a demo program and immerse yourself in a VR world. There are several to choose from, and each one demonstrates the features of the Python–VRZero program. The demos need to be run using Python 3 and executed as a script from the **demos** folder. (If you are using a Oculus Rift you will need to navigate to the folder via the display inside the Rift headset.) Open the LX Terminal, and move to the python-vrzero/demos folder, line one. To list the available demos type ls, this will list the file names of all the demos. To run a demo type ./ followed by the name of the demo, for example to run the abbey demo type, **./abbey.py** (line 2). You will be presented with a VR render of Buckfast Abbey, to end the environment just press Escape on the keyboard.

```
cd python-vrzero/demos
./abbey.py
```



```
import pi3d
from vrzero import engine

# VR Zero init, must be done *before* Pi3D setup.
engine.init()

# Pi3D scene setup...

shader = pi3d.Shader("uv_light")
shinesh = pi3d.Shader("uv_reflect")
flatsh = pi3d.Shader("uv_flat")
matsh = pi3d.Shader("mat_reflect")
##########################################
# Load textures
patimg = pi3d.Texture("textures/PATRN.PNG")
coffimg = pi3d.Texture("textures/COFFEE.PNG")
shapebump = pi3d.Texture("textures/floor_nm.jpg")
shapeshine = pi3d.Texture("textures/stars.jpg")
light = pi3d.Light(lightpos=(-1.0, 0.0, 10.0), lightcol=(3.0,
```

Editing the textures

15 If you have used Pi3D before you can access the program template to set up your own models. If not, then change the textures in the Shape demo program. First open the LXTerminal and type sudo idle 3 to load Python 3. Select File and open, navigate to the following folder **/home/pi/python-vrzero/demos** and select the shapes.py program. Locate line 14 which begins **patimg = pi3d** (pictured, top of the page). This is the first line of code which tells the program which textures to load for each shape. There are several after which can also be edited.

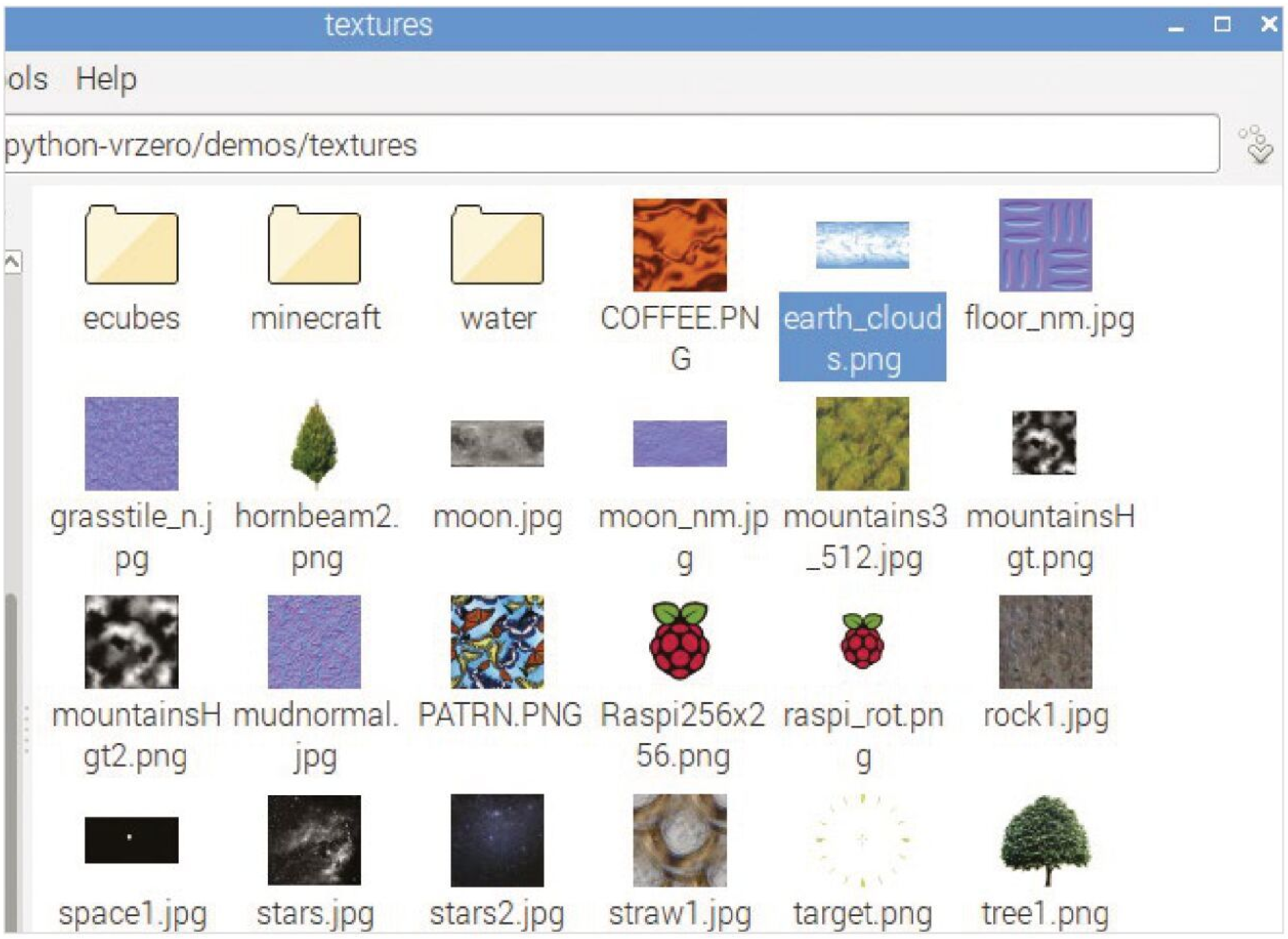
Try some other demos

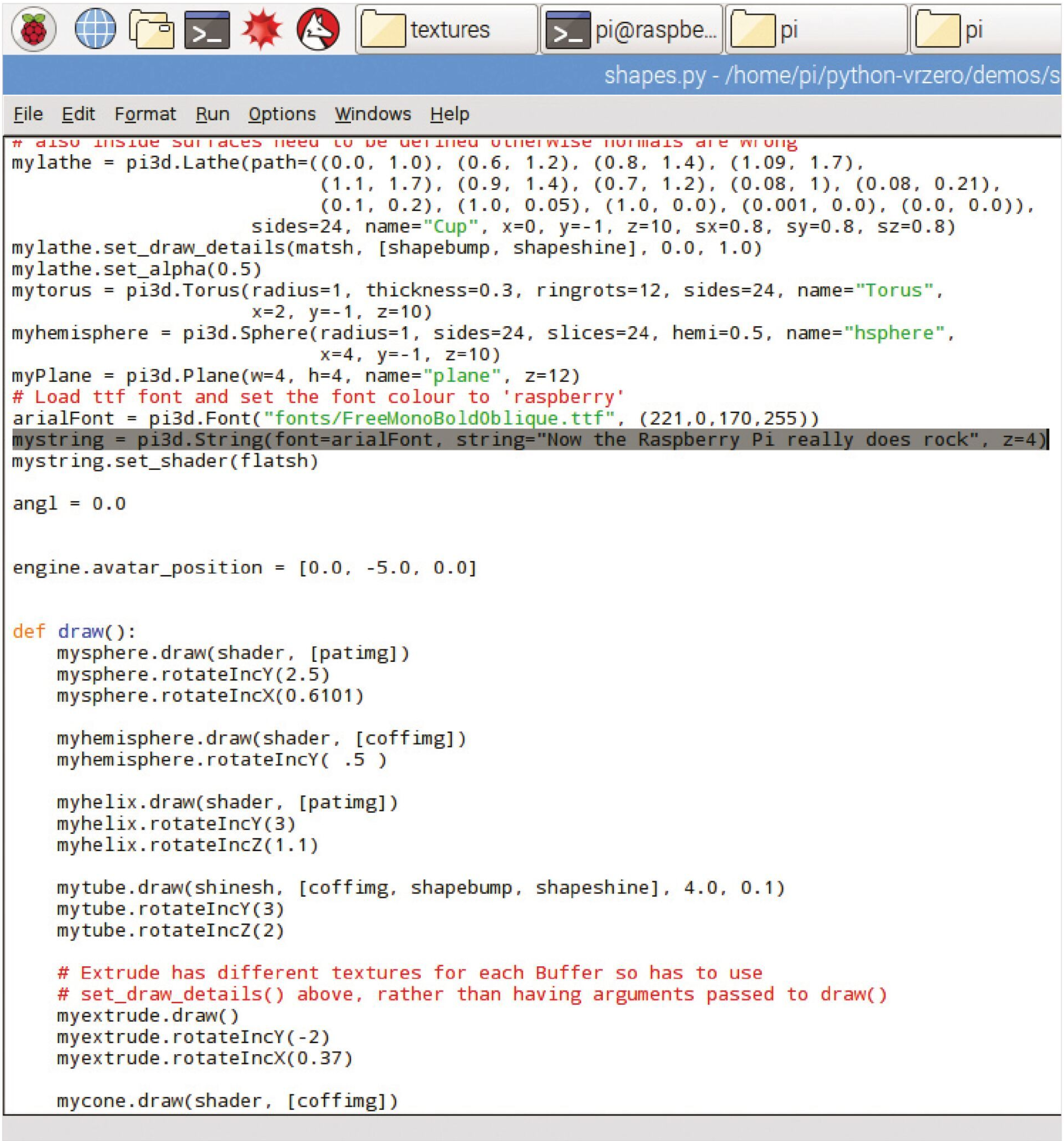
You may be interested in trying out some other demonstrations which are availble at **https://github.com/pi3d/pi3d_demos.** Try riding a Roller Coaster or driving a tank! This resource also provides a guide how to create your own models using the Pi3D python library and code.

Rift Development Kit 2

16 Using the folder explorer, click the file icon to navigate to the textures in the texture folder **/home/pi/python-vrzero/demos/textures.** You will see the files that are used for the shapes demo. Replace the image file with one of your own and then on line 14 of the program change the file name to match your selected image file choice.

If you don't want to use your own texture file then you can change the file name to one of the other image files listed in the folder. Press F5 to save and run the demo. You will notice that the shape textures have changed.


textures
ols Help
python-vrzero/demos/textures
ecubes
minecraft
water
COFFEE.PNG
earth_clouds.png
floor_nm.jpg
grasstile_n.jpg
hornbeam2.png
moon.jpg
moon_nm.jpg
mountains3_512.jpg
mountainsHgt.png
mountainsHgt2.png
mudnormal.jpg
PATRN.PNG
Raspi256x256.png
raspi_rot.png
rock1.jpg
space1.jpg
stars.jpg
stars2.jpg
straw1.jpg
target.png
tree1.png


textures
pi@raspbe...
pi
pi
shapes.py - /home/pi/python-vrzero/demos/s
File Edit Format Run Options Windows Help

```
# also inside surfaces need to be defined otherwise normals are wrong
mylathe = pi3d.Lathe(path=((0.0, 1.0), (0.6, 1.2), (0.8, 1.4), (1.09, 1.7),
                           (1.1, 1.7), (0.9, 1.4), (0.7, 1.2), (0.08, 1), (0.08, 0.21),
                           (0.1, 0.2), (1.0, 0.05), (1.0, 0.0), (0.001, 0.0), (0.0, 0.0)),
                     sides=24, name="Cup", x=0, y=-1, z=10, sx=0.8, sy=0.8, sz=0.8)
mylathe.set_draw_details(matsh, [shapebump, shapeshine], 0.0, 1.0)
mylathe.set_alpha(0.5)
mytorus = pi3d.Torus(radius=1, thickness=0.3, ringrots=12, sides=24, name="Torus",
                     x=2, y=-1, z=10)
myhemisphere = pi3d.Sphere(radius=1, sides=24, slices=24, hemi=0.5, name="hsphere",
                           x=4, y=-1, z=10)
myPlane = pi3d.Plane(w=4, h=4, name="plane", z=12)
# Load ttf font and set the font colour to 'raspberry'
arialFont = pi3d.Font("fonts/FreeMonoBoldOblique.ttf", (221,0,170,255))
mystring = pi3d.String(font=arialFont, string="Now the Raspberry Pi really does rock", z=4)
mystring.set_shader(flatsh)

angl = 0.0


engine.avatar_position = [0.0, -5.0, 0.0]


def draw():
    mysphere.draw(shader, [patimg])
    mysphere.rotateIncY(2.5)
    mysphere.rotateIncX(0.6101)

    myhemisphere.draw(shader, [coffimg])
    myhemisphere.rotateIncY( .5 )

    myhelix.draw(shader, [patimg])
    myhelix.rotateIncY(3)
    myhelix.rotateIncZ(1.1)

    mytube.draw(shinesh, [coffimg, shapebump, shapeshine], 4.0, 0.1)
    mytube.rotateIncY(3)
    mytube.rotateIncZ(2)

    # Extrude has different textures for each Buffer so has to use
    # set_draw_details() above, rather than having arguments passed to draw()
    myextrude.draw()
    myextrude.rotateIncY(-2)
    myextrude.rotateIncX(0.37)

    mycone.draw(shader, [coffimg])
```

Alter the message

17 Return to your Python editor and locate line 71. This holds the message which is displayed in the shapes VR demo. Change the text to a sentence of your choice. Save and run the program. Congratulations you have now begun to modify your own VR demos. Experiment with the program files for each of the demos editing the textures. For example, how about creating a church made out of chocolate? If you want to try other demos, find additional details at **https://github.com/pi3d/pi3d_demos.**

SONY
Beacon config
5:53
ACTION
Show Mona Lisa
Open website
Open application
Play alarm
Silent phone
Tasker
CANCEL
BEACON CONFIG
Wireless by Nordic
HDMI

Use your Raspberry Pi to find and track your phone

Create a program that locates Bluetooth devices and responds to them

What you'll need…

Raspberry Pi 3

Bluetooth USB dongle (if using an older Pi model)

The Raspberry Pi model 3 saw the introduction of embedded Wi-Fi and Bluetooth capabilities. This now makes it even easier to interact with Bluetooth-enabled devices such as mobile phones, tablets and speakers. The Python programming language supports a range of libraries that enable you to interact, monitor and control various elements of a Bluetooth device. This tutorial combines the Pi's Bluetooth hardware with Python code to create three simple but useful programs. First, build a short program to search for Bluetooth-enabled devices and return the 12-part address of each device. Once you have obtained the addresses, you can then scan and find Bluetooth services that are available on that particular device. Finally, use the Bluetooth address and some conditions to check which devices are present in a building and in turn, which people are present or absent in a building, responding with a desired action – it's a kind of automated Bluetooth checking-in system.

Using Bluetooth

01 Bluetooth is a wireless standard for exchanging data between devices over short distances of between one and ten metres. The current version, Bluetooth v5, was notified in June 2016 and has an increased range of over 200 metres. It was released in 2017 and will probably be a staple of many IoT devices and applications. Bluetooth uses the standard IEEE 802.11, which is the same standard as Wi-Fi. They both have similarities such as setting up a connection, transferring and receiving files and streaming audio and media content. If you have a Pi 2 or lower, you can still create and use these programs by using a Bluetooth USB dongle.

Install the required libraries

02 Although the Raspberry Pi OS image comes with a Bluetooth library for interfacing with devices, for this tutorial you will want to control the interface with Python code. Load up your Pi and open the LX Terminal window. Check for and update/upgrade the OS, typing in lines 1 and 2. Then install the Python development tools, line 3. Finally install two further Bluetooth development libraries. Once they have completed, restart your Pi by typing sudo halt.

```
  sudo apt-get update
sudo apt-get upgrade
       sudo apt-get install python-pip python-dev ipython
sudo apt-get install bluetooth
libbluetooth-dev
sudo pip install pybluez
```

Load Python

03 Load the LX Terminal and type sudo idle, this will open the Python editor with super-user privileges, which will give you access to the USB hardware via Python code. Start a new Window and import the first Bluetooth module, line 1. Then add a short message to inform the user that the program is searching for nearby devices.

```
 import Bluetooth
print(“Searching for device...”)
```

Search for the names of the devices

04 The next line of your program searches for the names of the Bluetooth enabled devices. Each device must have Bluetooth enabled and be discoverable in order to be found. On the next line down, create a variable called nearby_devices to store the names and use the code bluetooth.discover_devices to look up the names of the devices.

```
 nearby_devices = bluetooth.discover_devices(lookup_names =
True)
```

Is your dongle working?

If you are using a USB Bluetooth Dongle then you can check that it is working by plugging it in, then restarting your Raspberry Pi by typing the command sudo reboot. When reloaded, check that the Dongle has been recognised; load the LX Terminal window and type lsusb. This will list all the connected USB devices. You can also type hcitool dev to identify the dongle and return its USB address.

Is your Bluetooth Dongle compatible?

If you have an older Raspberry Pi model 1, 2 or the Pi Zero then Bluetooth capability is not included. However, you can buy a USB Bluetooth dongle and attach it via one of the USB ports to add capability. Not all Bluetooth dongles are compatible so there is a developing list of the tried and tested ones available. Check here before you purchase one: http://elinux.org/RPi_USB_Bluetooth_adapters

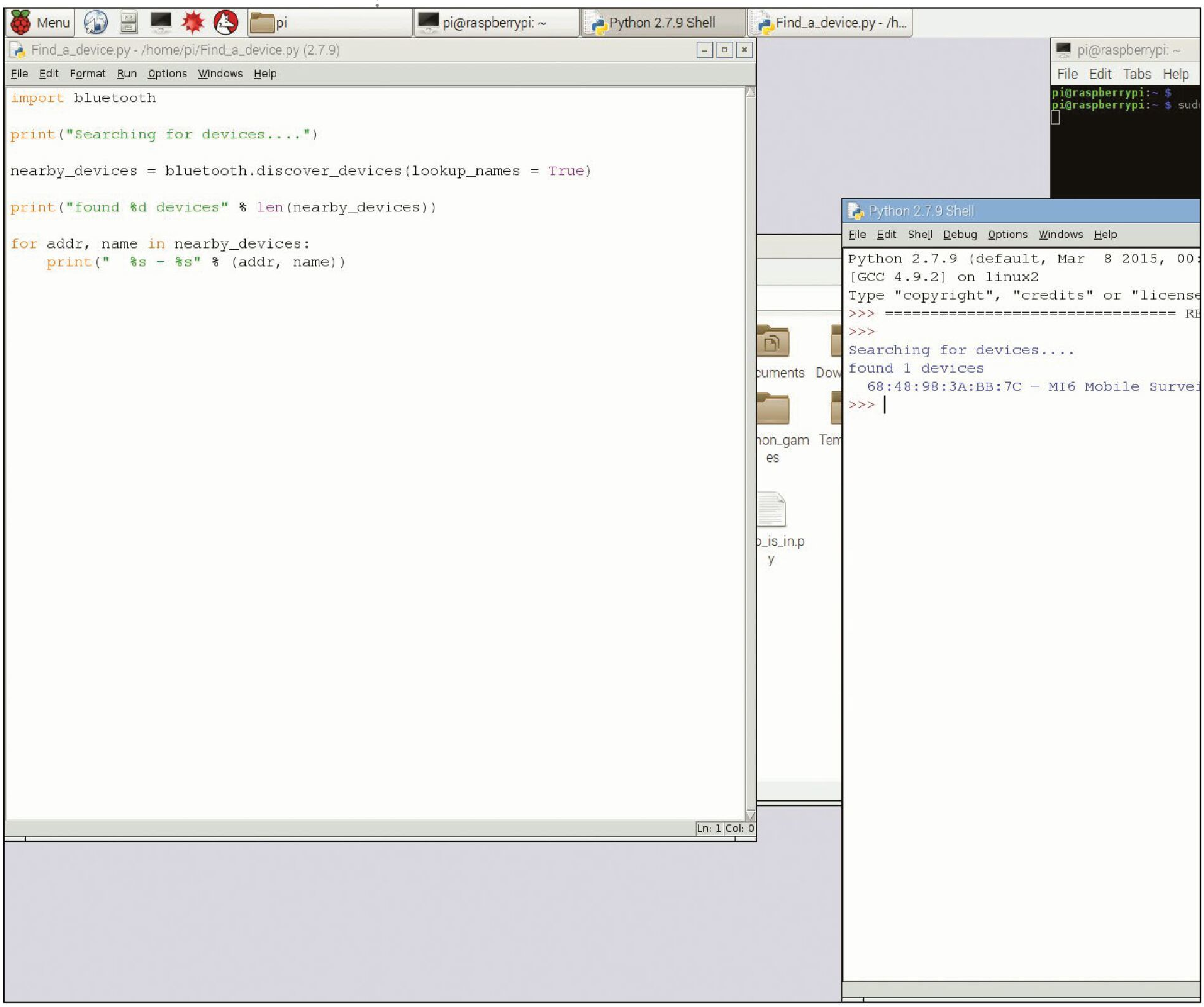
Print the total number of devices found

05 Each of the names of any discoverable devices are now stored in a variable. Use the code len(nearby_devices) to return the number of items stored in the variable, this is the number of Bluetooth devices the program has found. Then print out the total number of devices. Add the following code after the previous line of your program.

```
print("found %d devices" % len(nearby_devices))
```

The Bluetooth address (BD_ADDR)

06 Each Bluetooth-enabled device has a Bluetooth address that is a combination of 12 alphanumeric characters; for example, 69:58:78:3A:CB:7F. The addresses are hexadecimal, which means they can contain numbers from 0 to 9 and letters from A to F. Most devices manufactures will include the address on a sticker attached to the hardware or within the user manual.



Menu
pi
pi@raspberrypi: ~
Python 2.7.9 Shell
Find_a_device.py - /h...
Find_a_device.py - /home/pi/Find_a_device.py (2.7.9)
File Edit Format Run Options Windows Help
Ln: 1 Col: 0
pi@raspberrypi: ~
File Edit Tabs Help
Python 2.7.9 Shell
File Edit Shell Debug Options Windows Help

```
import bluetooth

print("Searching for devices....")

nearby_devices = bluetooth.discover_devices(lookup_names = True)

print("found %d devices" % len(nearby_devices))

for addr, name in nearby_devices:
    print("  %s - %s" % (addr, name))
```

```
pi@raspberrypi:~ $
pi@raspberrypi:~ $ sud
```

```
Python 2.7.9 (default, Mar  8 2015, 00:
[GCC 4.9.2] on linux2
Type "copyright", "credits" or "license
>>> ================================ RE
>>>
Searching for devices....
found 1 devices
  68:48:98:3A:BB:7C - MI6 Mobile Survei
>>> 
```

Full code listing

```
import bluetooth

print(“Searching for devices....”)

nearby_devices = bluetooth.discover_devices(lookup_
names = True)

print(“found %d devices” % len(nearby_devices))

for addr, name in nearby_devices:
    print(“  %s - %s” % (addr, name))

#  [Find a list of services].py

#!/usr/bin/env python
import bluetooth
from bluetooth import *

device_address = “98:44:98:3A:BB:7C”

#find services on the phone
services = find_service(address=device_address)
#print services

for i in services:
    print i, ‘\n’

#  [Check to see who is in].py

#!/usr/bin/python
### add a def and then a while statement
import bluetooth
import time

print “Blue-Who Finder”

#find the devices and the name of the device
devices = bluetooth.discover_devices(lookup_names =
True)

#print how many devcies are found
print(“Found %d devices” % len(devices))

#print the devices and the names
for addr, name in devices:
    print(“  %s - %s” % (addr, name))

time.sleep(2)
print “Check to see who is in the building”
print “Checking “ + time.strftime(“%a, %d %b %Y
%H:%M:%S”, time.gmtime())
time.sleep(1)
if len (devices) == 0:
        print “No one is currently in the building”

#check the addresses against list to see who is near
for person in devices:

   device = bluetooth.lookup_name(“68:88:98:3R:BB:7C”,
timeout=5)
   if (device != None):
       print “TeCoEd is in”
   else:
       print “Tecoed is out”

   time.sleep(1)

   device2 = bluetooth.lookup_name(‘CC:3B:4F:CA:5B:1A’,
timeout=5)
   if (device2 != None):
       print “The Boss is in the building, back to
work”
   else:
       print “The Boss is still out, Facebook time!”

   time.sleep(1)

   device3 = bluetooth.lookup_name(“00:26:DF:6F:D2:C8”,
timeout=5)
   if (device3 != None):
       print “Wow Sherlock is here O wise one!”
   else:
       print “Sherlock is still out on a case”

   time.sleep(1)

   device4 = bluetooth.lookup_name(“28:18:78:47:0C:56”,
timeout=5)
   if (device4 != None):
       print “Babbage is present in the building”
   else:
       print “Babbage is not here”

   device5 = bluetooth.lookup_name(“E0:W8:47:77:6F:41”,
timeout=5)
   if (device4 != None):
       print “We have a Bogie in the area!”
   else:
       print “Airspace is clear”
```

“The Python programming language supports a range of libraries that enable you to interact, monitor and control various elements of a Bluetooth device”

Variables

A variable is a location in the computer's memory where you can store data. In order to find the data again you give the variable a suitable name or label. For example, days = 5. This means that the 'days' variable current holds the number five.

Print the name and address of the device

07 For each of the devices that the program has located, (each of the items in the list), print out the address of the device and also the name of the device. This information is used in the next sections to find out what available services a device has and also to add an action when a device is found. Save the program and then run it, ensuring that the any devices to be found are in Discovery mode. You will be presented with a list of the devices that includes the name and address of each.

```
for addr, name in nearby_devices:
  print(“  %s - %s” % (addr, name))
```

Find the available services on a Bluetooth device

08 Run the previous program and write down the Bluetooth address of the device. Start a new Python program and save it. Next open up a new Python window and start a new program. Input the two required libraries, lines 1 and 2.

```
 #!/usr/bin/env python
import bluetooth
from bluetooth import *
```

Set up the address to find

09 On the next line down, enter the address of the device that you want to find the services on. Use the previous program or look at the sticker to obtain the address. Next, create a variable called 'device_address' to store the address. Use the following code and replace the example address with the Bluetooth address of your device.

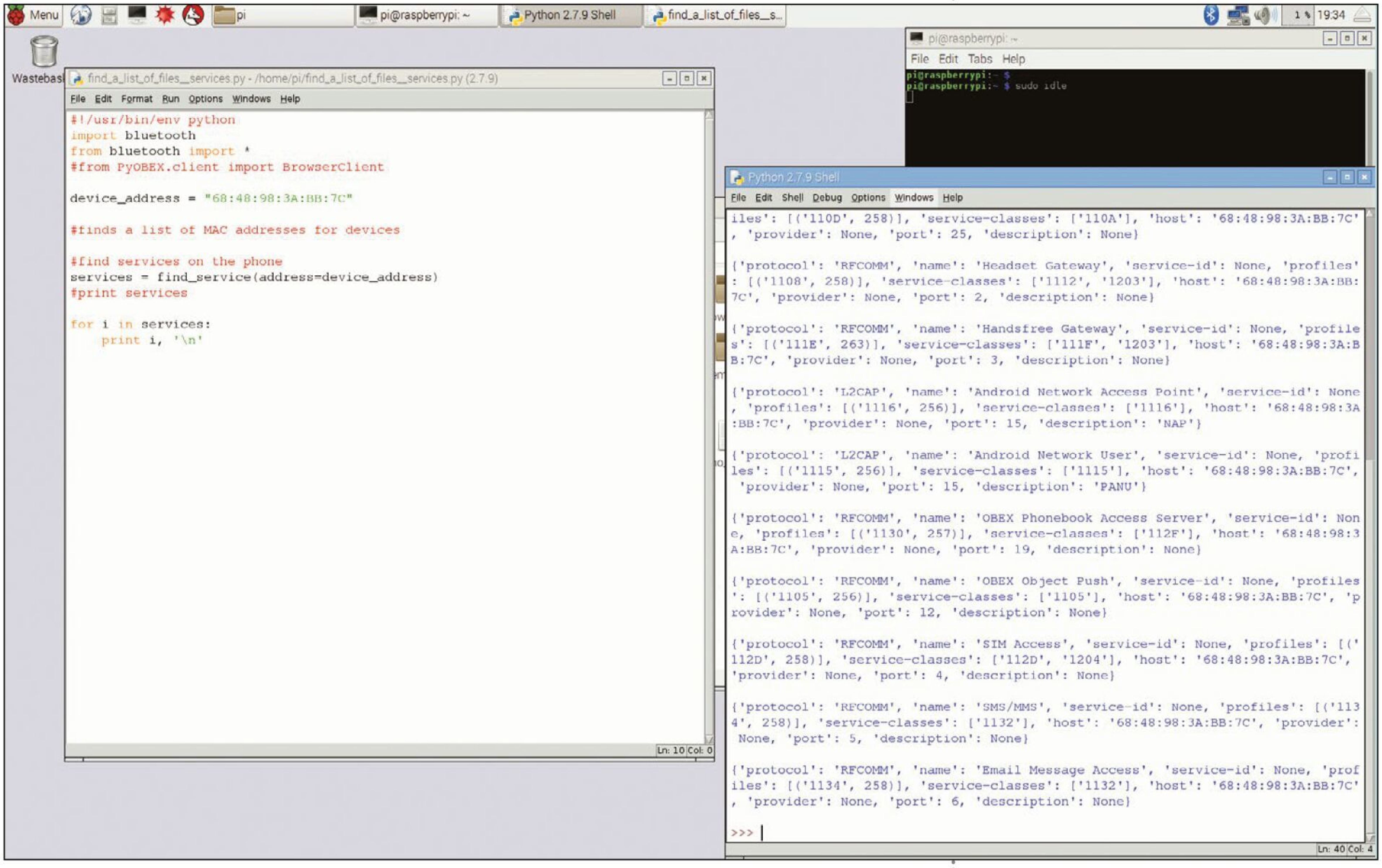
```
device_address = “69:58:78:3A:CB:7F” # enter address of device
```

Find a service

10 On the next line down, add the code to find the services that your device supports. Create a new variable called services, which will store a list of the services. Use the code, find_services, followed by the Bluetooth address of your enabled device to search through a list of available services and store each of them in the 'services' variable.

```
services = find_service(address=device_address)
```

"Each Bluetooth-enabled device has a Bluetooth address that is a combination of 12 alphanumeric characters"


Menu
pi
pi@raspberrypi: ~
Python 2.7.9 Shell
find_a_list_of_files_s...
Wastebasket
find_a_list_of_files__services.py - /home/pi/find_a_list_of_files__services.py (2.7.9)
File Edit Format Run Options Windows Help
Ln: 10 Col: 0
File Edit Tabs Help
File Edit Shell Debug Options Windows Help
Ln: 40 Col: 4

```
#!/usr/bin/env python
import bluetooth
from bluetooth import *
#from PyOBEX.client import BrowserClient

device_address = "68:48:98:3A:BB:7C"

#finds a list of MAC addresses for devices

#find services on the phone
services = find_service(address=device_address)
#print services

for i in services:
    print i, '\n'
```

```
pi@raspberrypi:~ $
pi@raspberrypi:~ $ sudo idle
```

```
iles': [('110D', 258)], 'service-classes': ['110A'], 'host': '68:48:98:3A:BB:7C'
, 'provider': None, 'port': 25, 'description': None}

{'protocol': 'RFCOMM', 'name': 'Headset Gateway', 'service-id': None, 'profiles'
: [('1108', 258)], 'service-classes': ['1112', '1203'], 'host': '68:48:98:3A:BB:
7C', 'provider': None, 'port': 2, 'description': None}

{'protocol': 'RFCOMM', 'name': 'Handsfree Gateway', 'service-id': None, 'profile
s': [('111E', 263)], 'service-classes': ['111F', '1203'], 'host': '68:48:98:3A:B
B:7C', 'provider': None, 'port': 3, 'description': None}

{'protocol': 'L2CAP', 'name': 'Android Network Access Point', 'service-id': None
, 'profiles': [('1116', 256)], 'service-classes': ['1116'], 'host': '68:48:98:3A
:BB:7C', 'provider': None, 'port': 15, 'description': 'NAP'}

{'protocol': 'L2CAP', 'name': 'Android Network User', 'service-id': None, 'profi
les': [('1115', 256)], 'service-classes': ['1115'], 'host': '68:48:98:3A:BB:7C',
 'provider': None, 'port': 15, 'description': 'PANU'}

{'protocol': 'RFCOMM', 'name': 'OBEX Phonebook Access Server', 'service-id': Non
e, 'profiles': [('1130', 257)], 'service-classes': ['112F'], 'host': '68:48:98:3
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{'protocol': 'RFCOMM', 'name': 'OBEX Object Push', 'service-id': None, 'profiles
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rovider': None, 'port': 12, 'description': None}

{'protocol': 'RFCOMM', 'name': 'SIM Access', 'service-id': None, 'profiles': [('
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'provider': None, 'port': 4, 'description': None}

{'protocol': 'RFCOMM', 'name': 'SMS/MMS', 'service-id': None, 'profiles': [('113
4', 258)], 'service-classes': ['1132'], 'host': '68:48:98:3A:BB:7C', 'provider':
 None, 'port': 5, 'description': None}

{'protocol': 'RFCOMM', 'name': 'Email Message Access', 'service-id': None, 'prof
iles': [('1134', 258)], 'service-classes': ['1132'], 'host': '68:48:98:3A:BB:7C'
, 'provider': None, 'port': 6, 'description': None}

>>> 
```

Print out each service

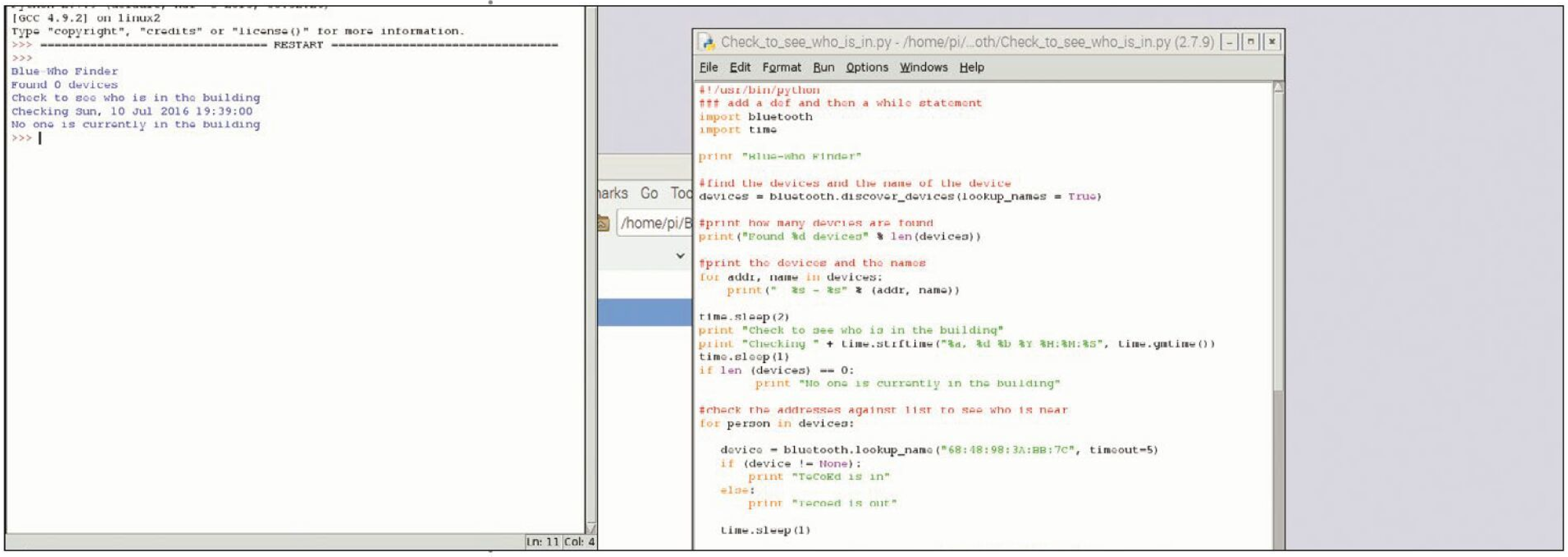
11 The last step of the program is to print out each of the services. These are stored in a list and therefore need to be printed out one line at a time. Create a loop using the code, for i in services, line 1. This loop will check for each of the individual items in the list. It will then print each of the items in the list, each Bluetooth service, line 2. Use the code '\n' to print each service onto a new line.

```
for i in services:
 print i, '\n'
```

What are the services?

12 Save and run your program and you will be presented with a long list of services, especially if you are using a modern device. Using these services with Python is more complex and requires several other lines of code. However, you can potentially transfer and receive files, stream music and even shut the device down. There are more details and commentary on the Blueman Github page, https://github.com/blueman-project/blueman. Remember though that these tools are purely for personal use.

> "You can transfer and receive files, stream music and even shut the device down"


Ln: 11 Col: 4
arks Go Too
/home/pi/B
Check_to_see_who_is_in.py - /home/pi/...oth/Check_to_see_who_is_in.py (2.7.9)
File Edit Format Run Options Windows Help

```
[GCC 4.9.2] on linux2
Type "copyright", "credits" or "license()" for more information.
>>> ================================ RESTART ================================
>>>
Blue-Who Finder
Found 0 devices
Check to see who is in the building
Checking Sun, 10 Jul 2016 19:39:00
No one is currently in the building
>>> 
```

```
#!/usr/bin/python
### add a def and then a while statement
import bluetooth
import time

print "Blue-who Finder"

#find the devices and the name of the device
devices = bluetooth.discover_devices(lookup_names = True)

#print how many devcies are found
print("Found %d devices" % len(devices))

#print the devices and the names
for addr, name in devices:
    print("  %s - %s" % (addr, name))

time.sleep(2)
print "Check to see who is in the building"
print "Checking " + time.strftime("%a, %d %b %Y %H:%M:%S", time.gmtime())
time.sleep(1)
if len (devices) == 0:
        print "No one is currently in the building"

#check the addresses against list to see who is near
for person in devices:

   device = bluetooth.lookup_name("68:48:98:3A:BB:7C", timeout=5)
   if (device != None):
       print "TeCoEd is in"
   else:
       print "Tecoed is out"

   time.sleep(1)
```

Find a device and a person

13 In Step 7 you used a short program to discover the Bluetooth-enabled device and check and return the address of the device. Now use the bluetooth.lookup_name code line to search for a particular device and return whether it is found or not. If it is found then the device is present and if not, then we can assume the device is not. However, remember that the Bluetooth may be turned off. In your Python program add the line to locate the device, replacing the example address with the address of the one that you want to locate.

```
device = bluetooth.lookup_name(“33:38:33:6A:BQ:7C”, timeout=5)
```

Respond if the device is found

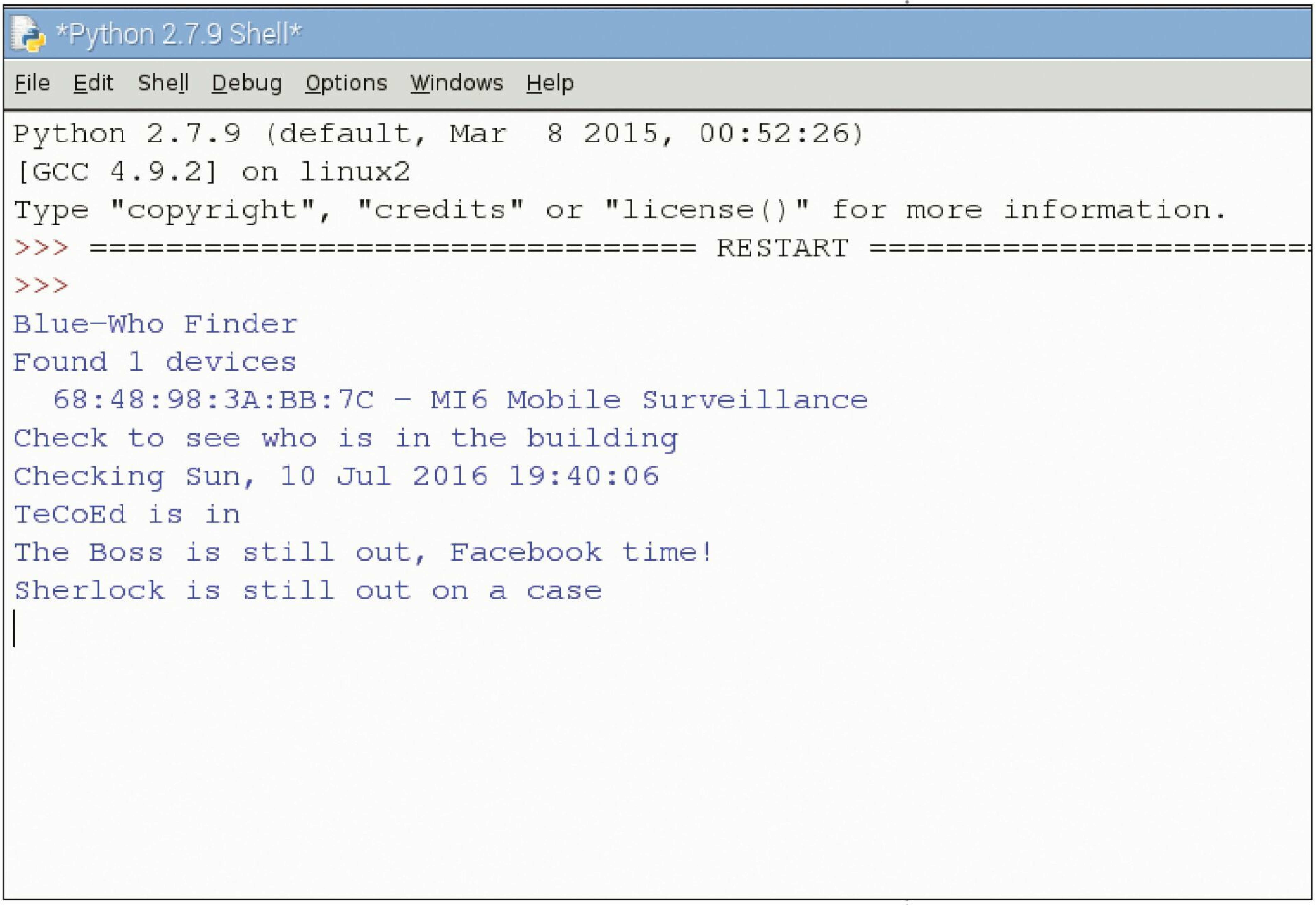
14 Once a device has been searched for, check to see if it is present and responds, line 1. Use an IF statement to see if the device is not found. This uses the symbol '!=', which means 'is not'. However, the code is checking if it is not 'None' – in other words the device is found. If it finds the named device then print out a message, line 2. If it does not find the device, line 3, then print out a message to notify the user, line 4. Add these lines of code underneath the previous line. Ensuring that your Bluetooth is enabled, save and run the program to find your device.

```
    if (device != None):
      print “TeCoEd is in”
  else:
      print “Tecoed is out”
```

Find a different device

15 To find other devices and respond with an action, simply use the same sequence of code but first create a different variable to store the response in. Add the code on the next line down and remember to de-indent it. Rename the variable, for example call it device_one and edit the address to match that of the second device.

```
 Device_one = bluetooth.lookup_name(“44:67:73:6T:BR:7A”, timeout=5)
```



```
Python 2.7.9 (default, Mar  8 2015, 00:52:26)
[GCC 4.9.2] on linux2
Type "copyright", "credits" or "license()" for more information.
>>> ================================ RESTART ========================
>>>
Blue-Who Finder
Found 1 devices
  68:48:98:3A:BB:7C - MI6 Mobile Surveillance
Check to see who is in the building
Checking Sun, 10 Jul 2016 19:40:06
TeCoEd is in
The Boss is still out, Facebook time!
Sherlock is still out on a case
```

Another response, the next device is found

16 As before, check and respond, line 1, using an IF statement to see if the device is not found. Remember to use the new variable name, in this example, device_one. If it finds the named device then print out a message, line 2. If it does not find the device, line 3, then print out a message to notify the user, line 4. Add these lines of code underneath the previous line. Save and run the program to find the two particular devices within your location.

```
    if (device_one != None):
      print “Linux Laptop is in”
   else:
     print “Linux Laptop is out”
```

Add an alternative action

17 To customise the project further you could add your own action to the devices on being discovered. For example, use a strip of LEDs to flash each time a device enters the location and is detected. Or use individual LEDs for each individual device to indicate if the device is present or not. How about combining the program with an LCD screen as a message board for who is present and who is out? For more inspiration, check out **https://www.youtube.com/watch?v=qUZQv87GVdQ**

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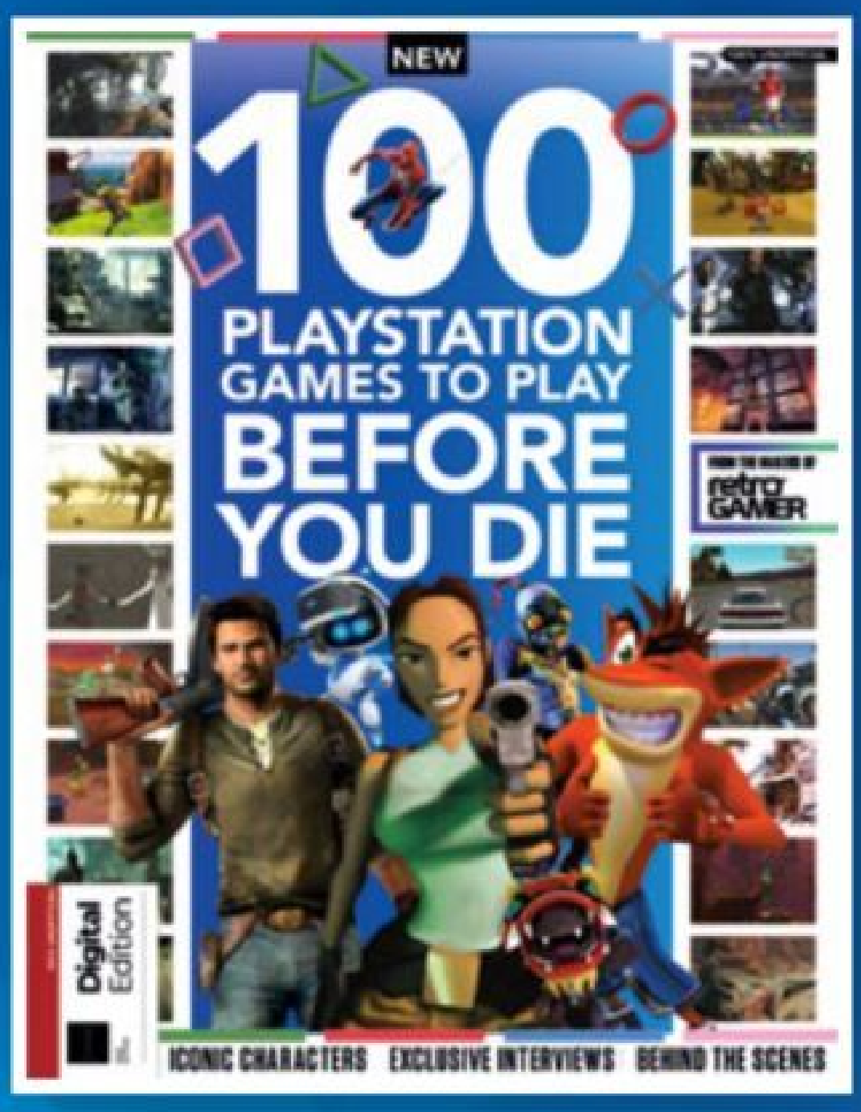
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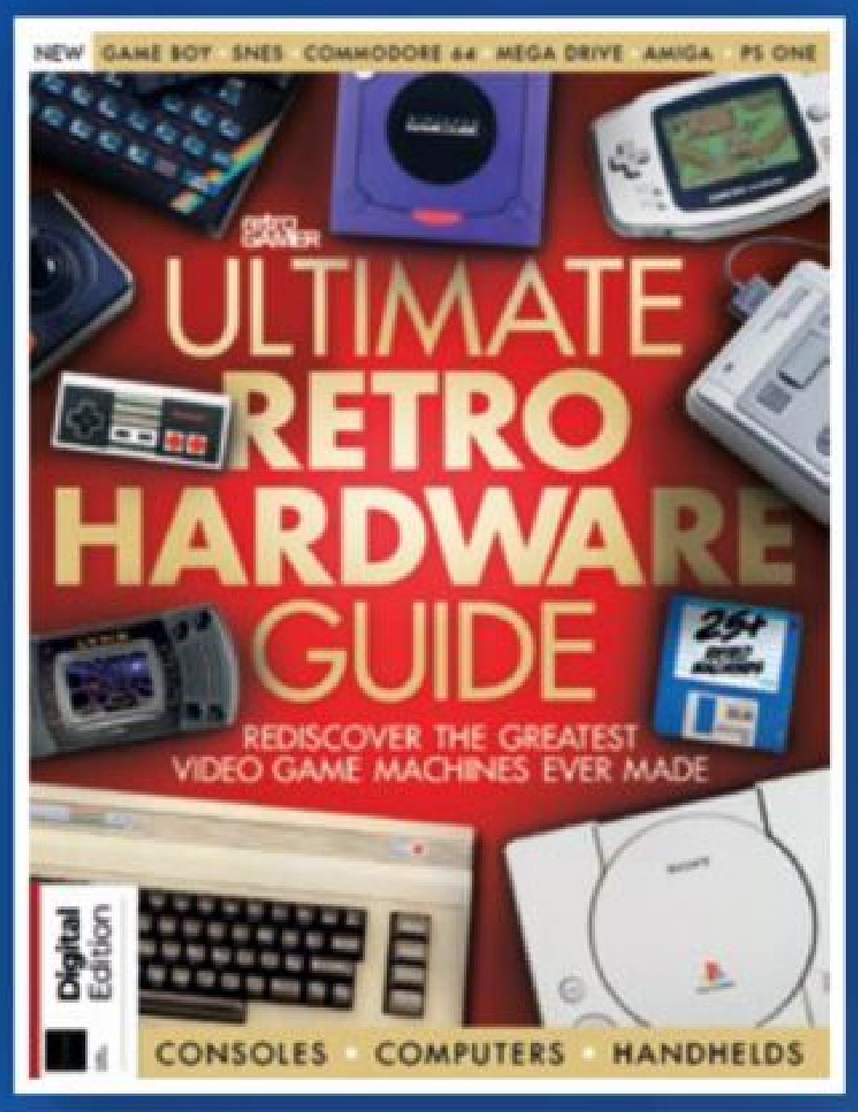
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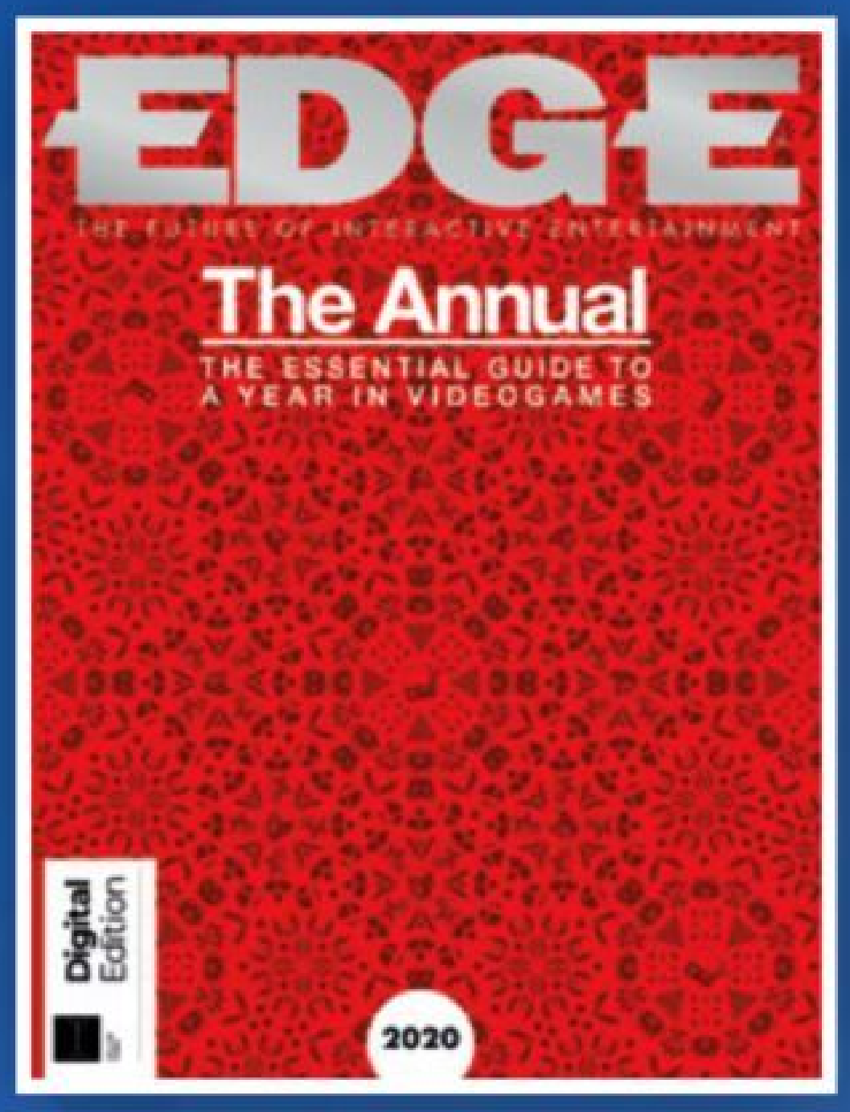
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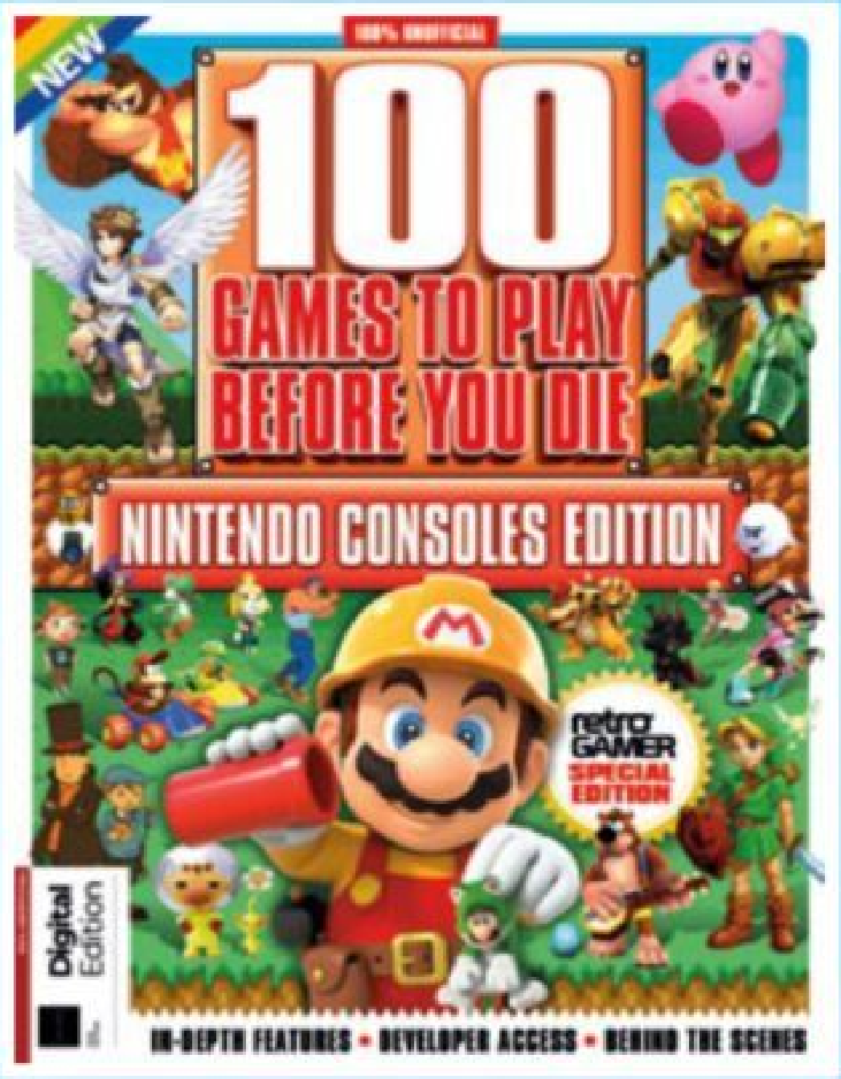
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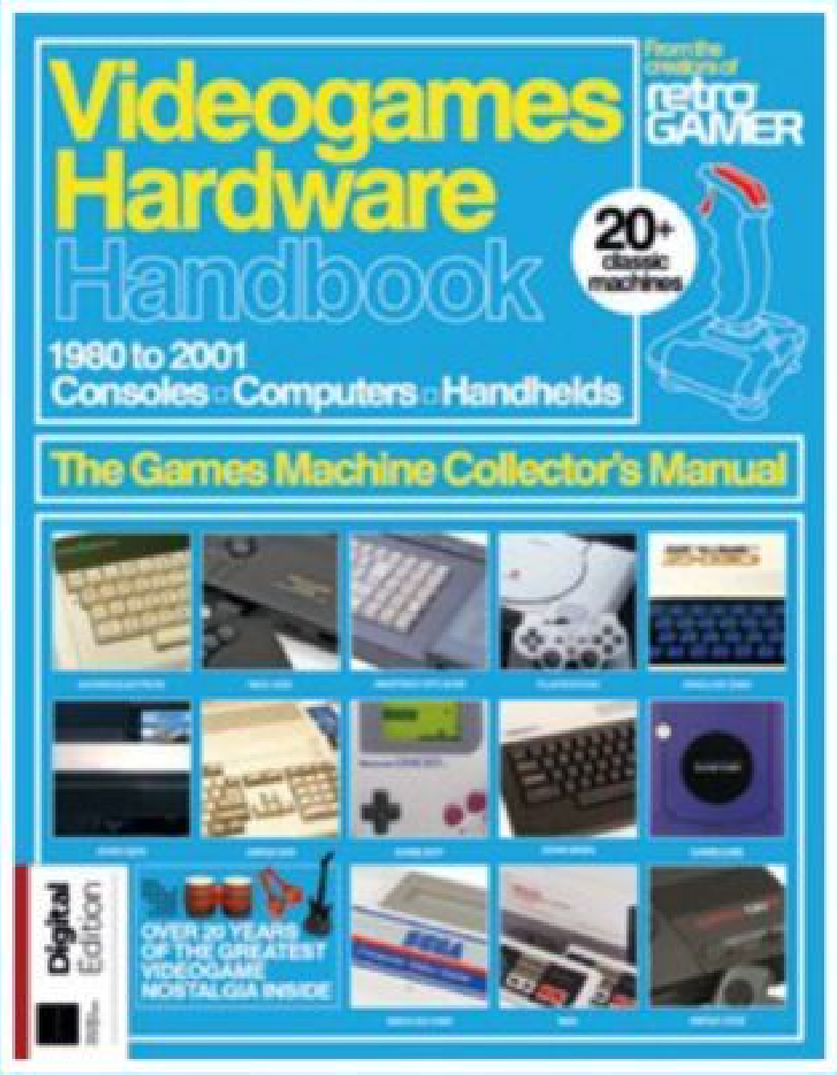
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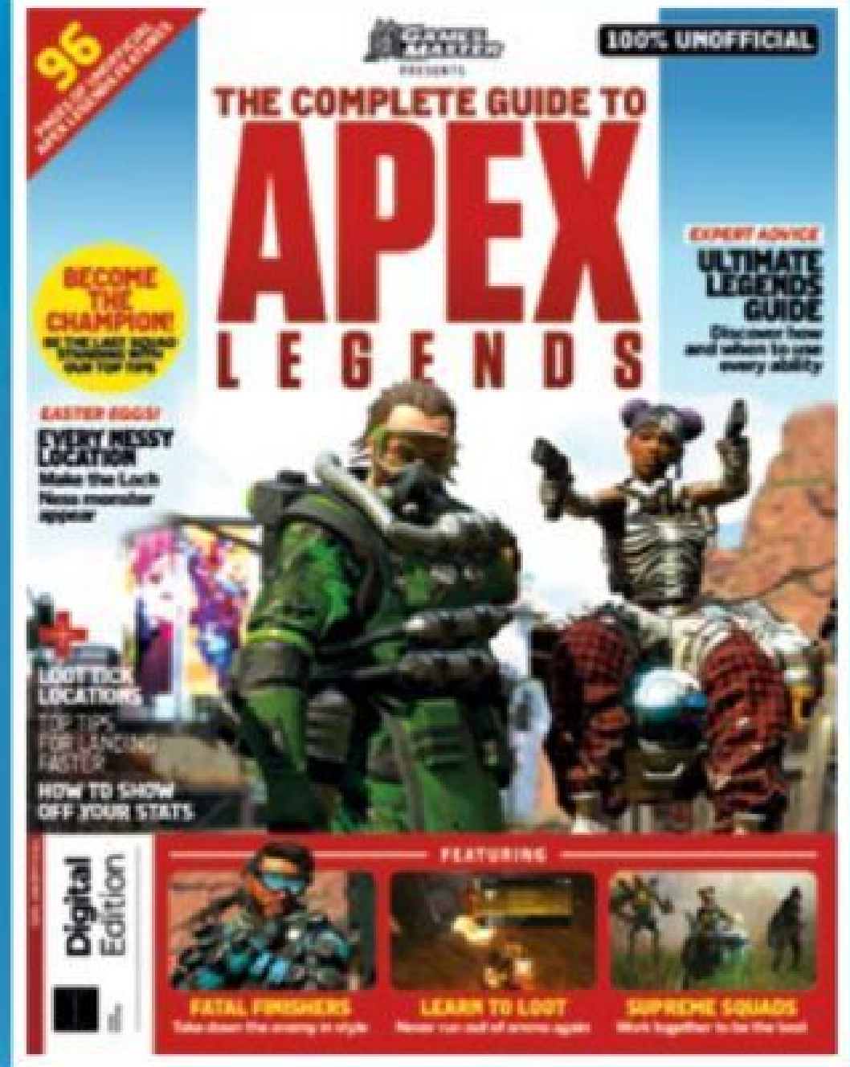
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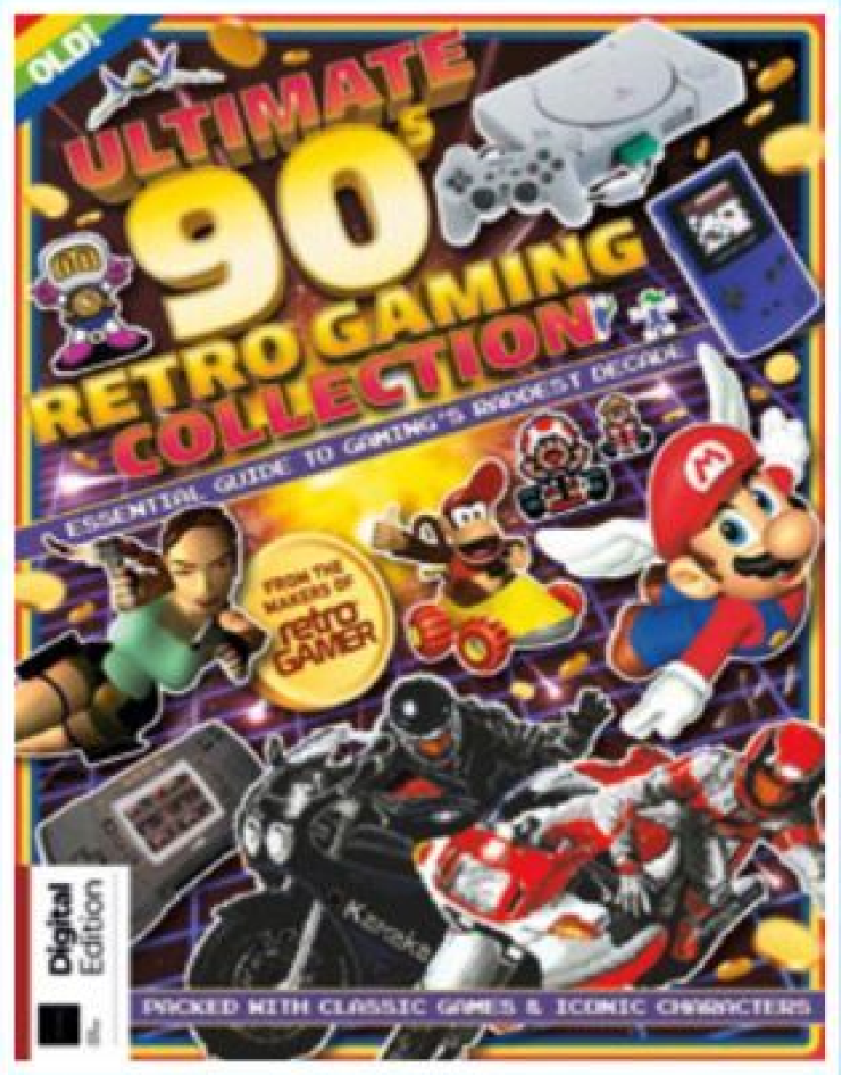
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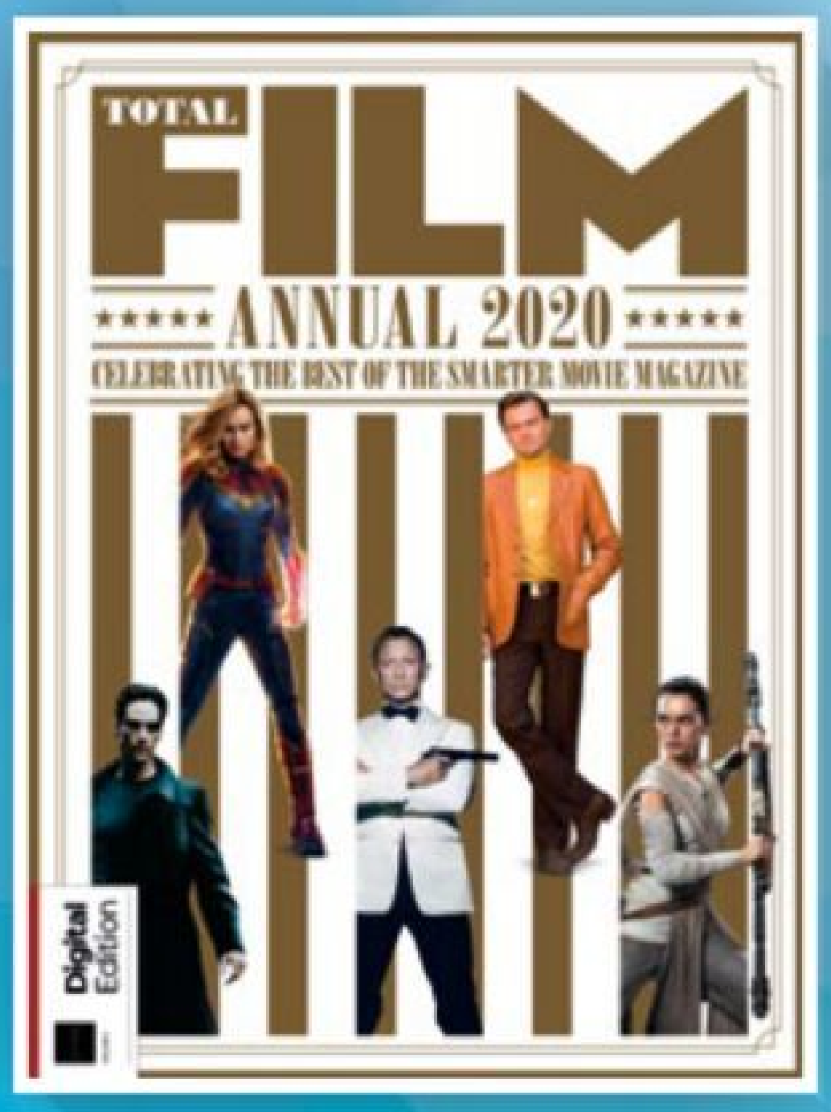
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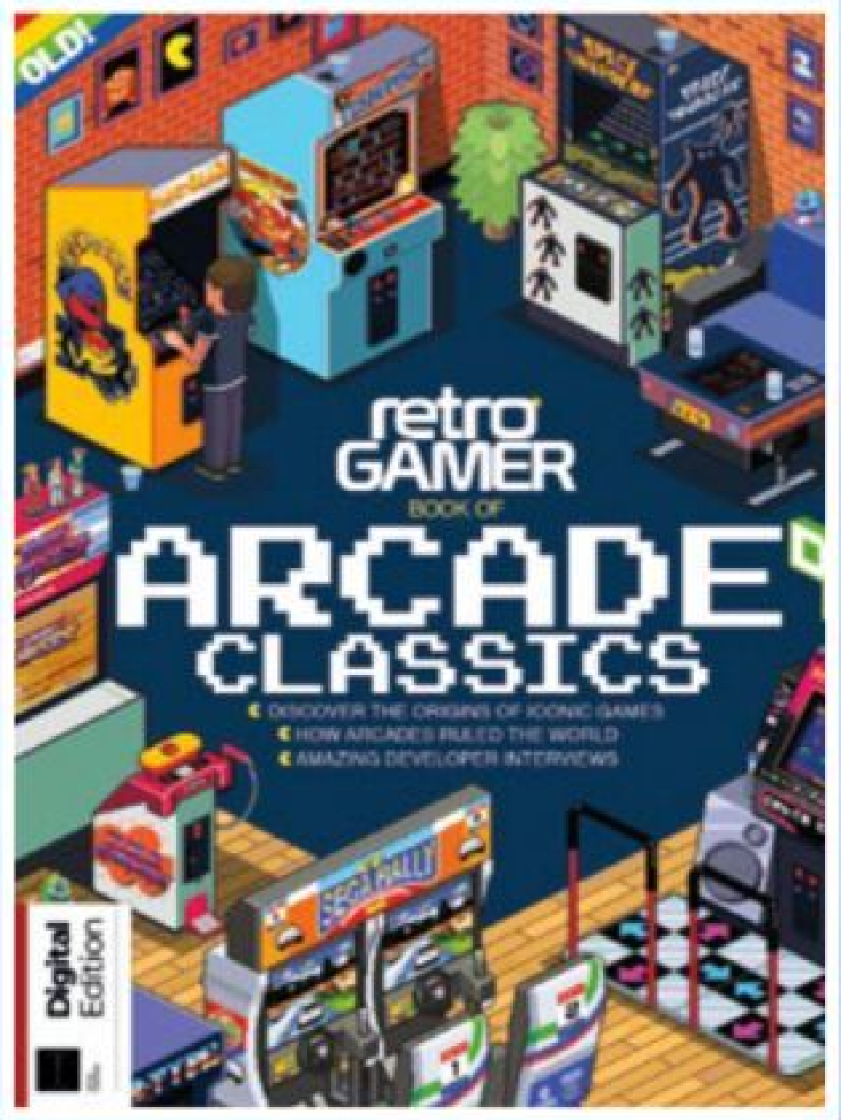
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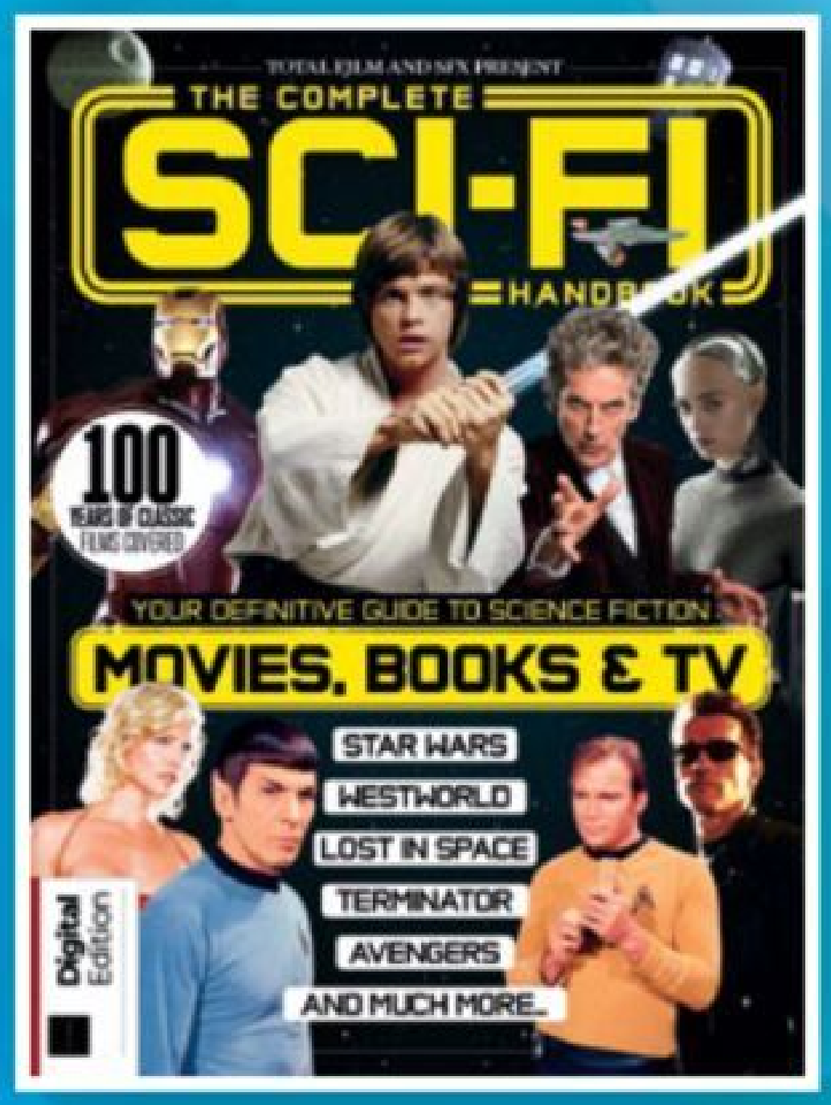
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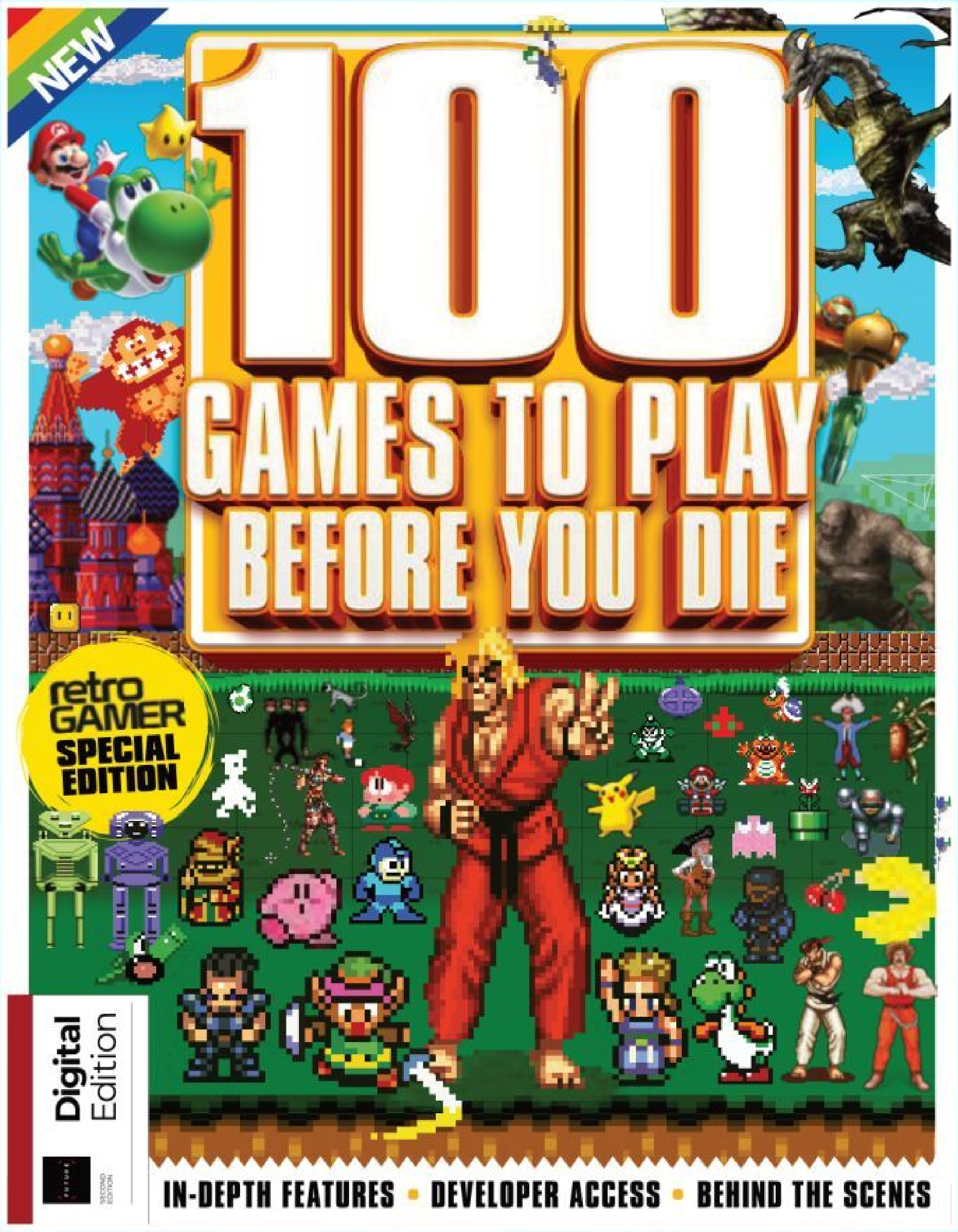
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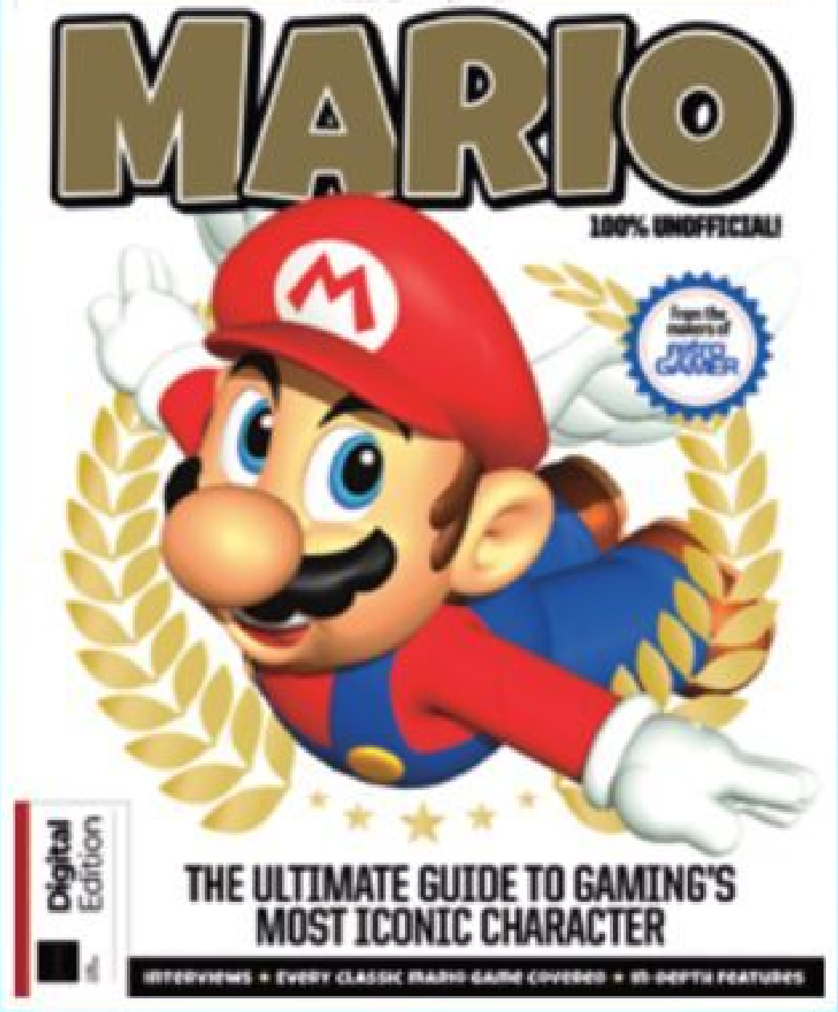
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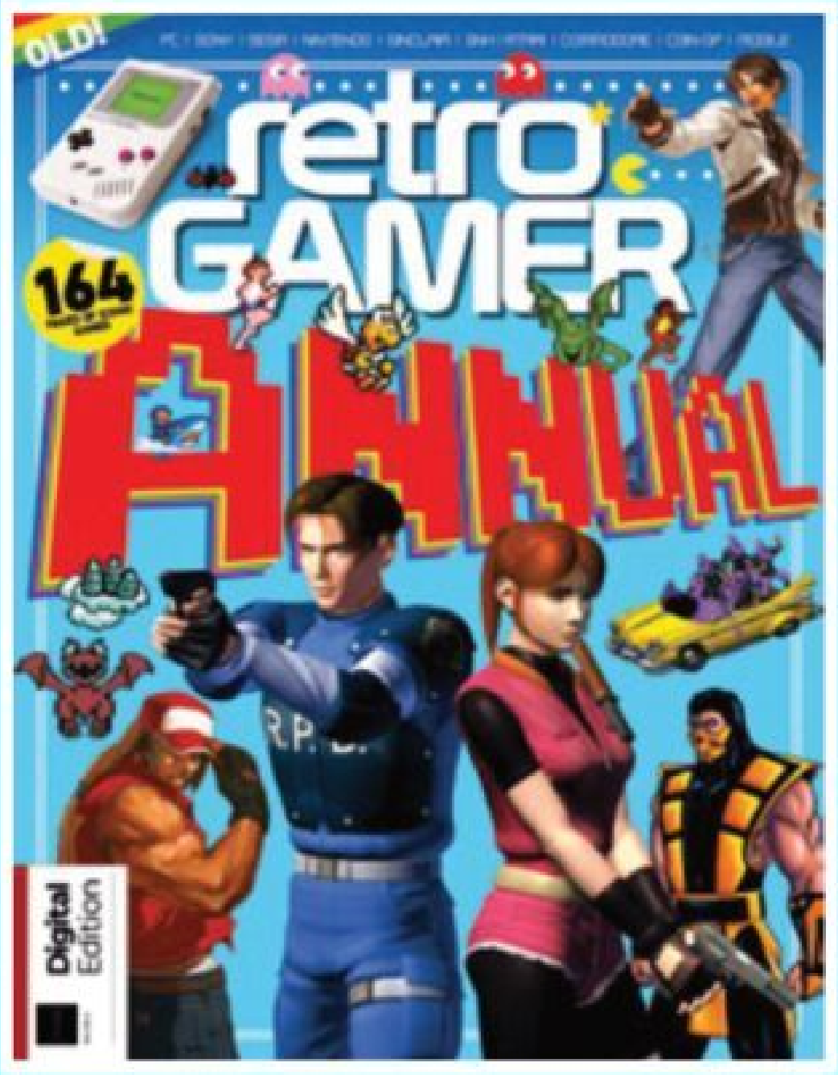
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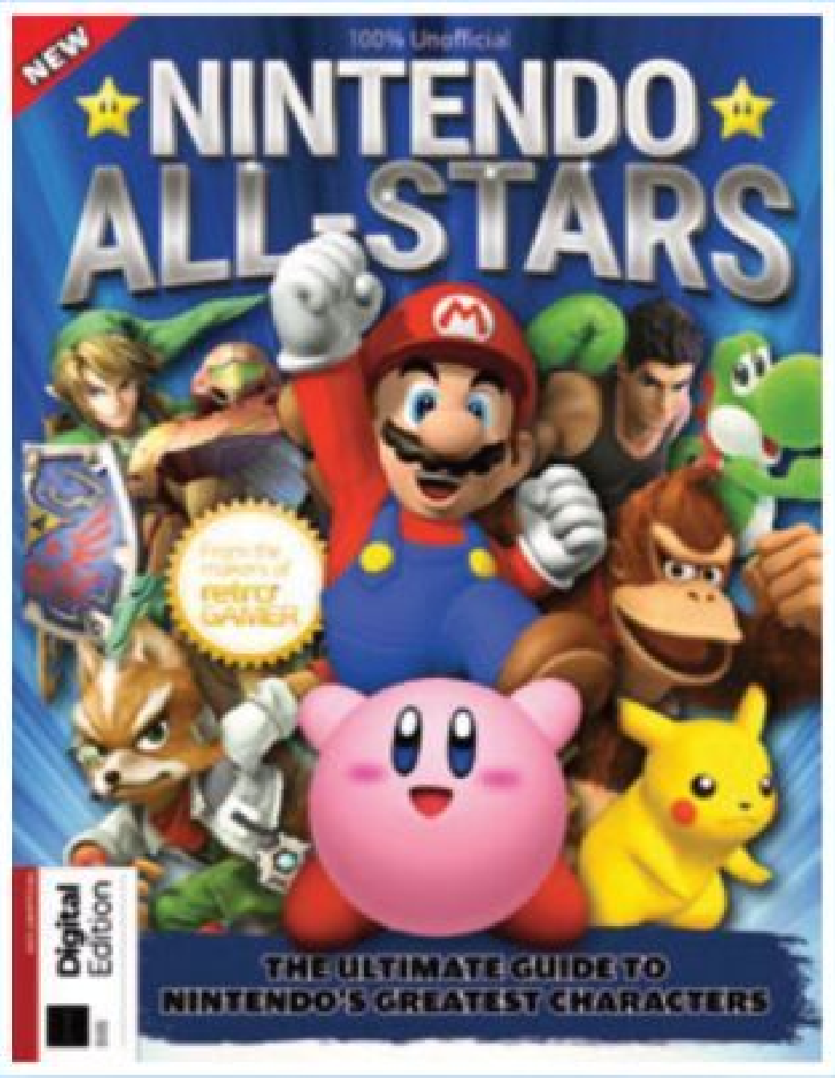
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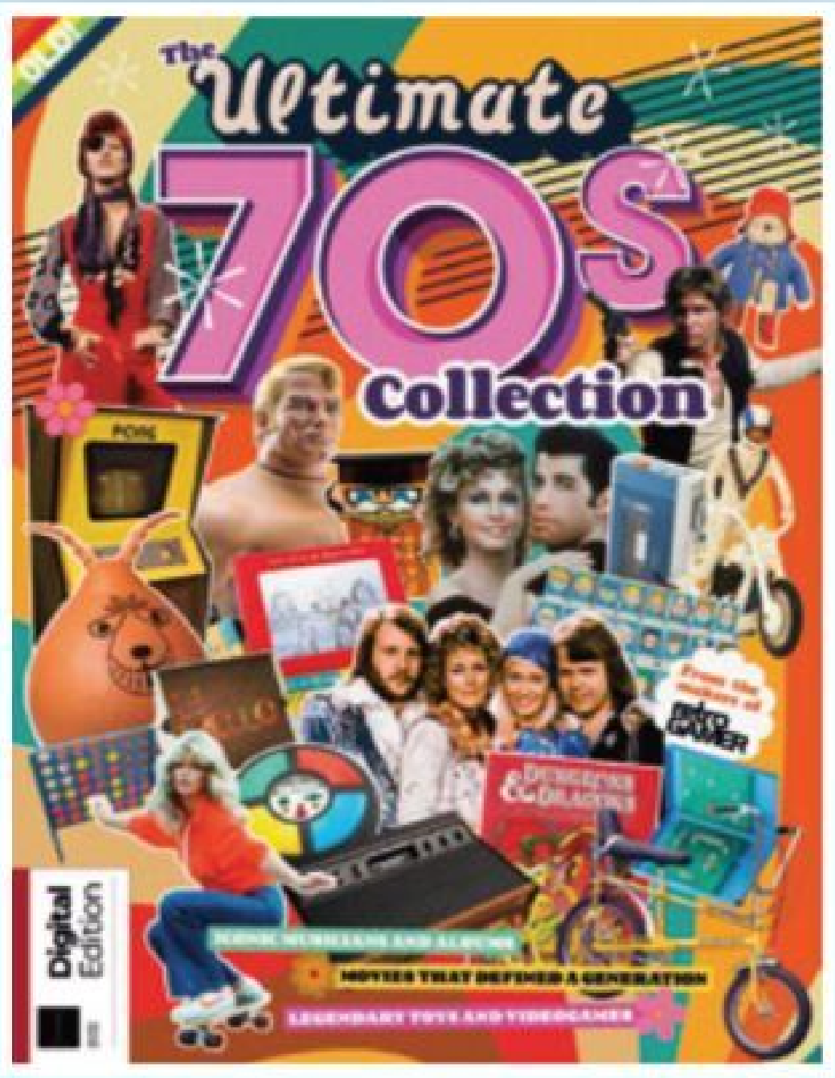
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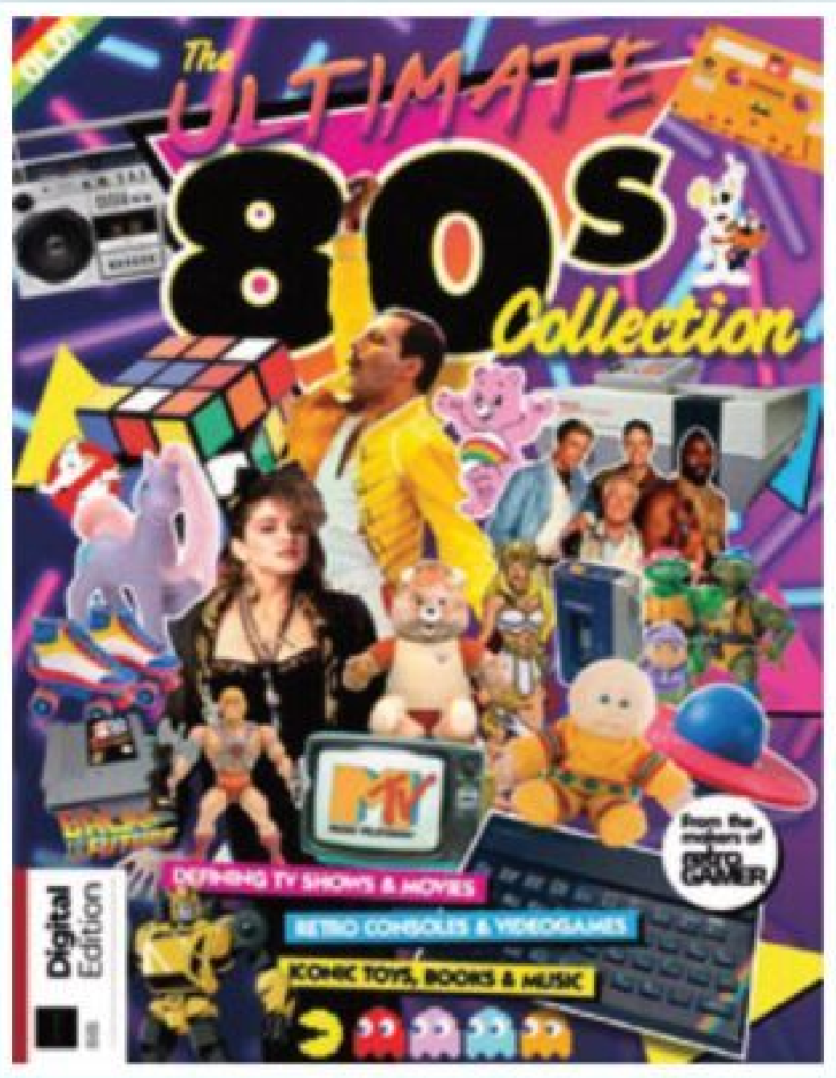
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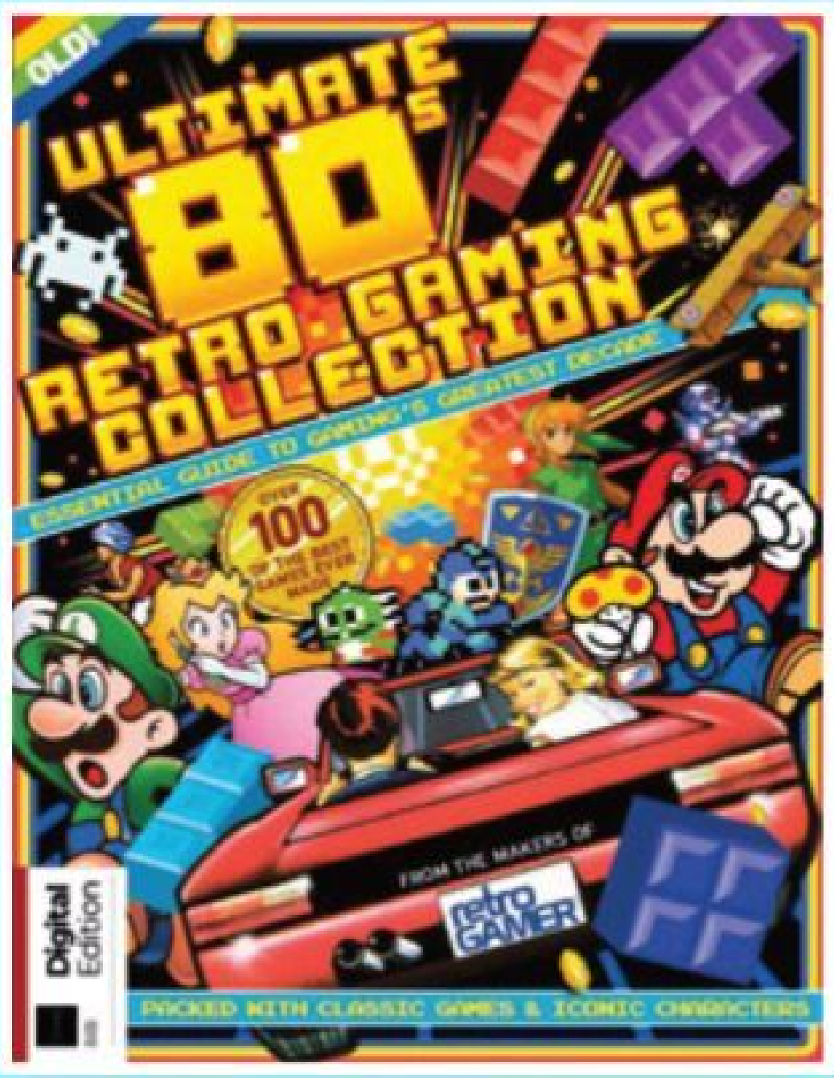
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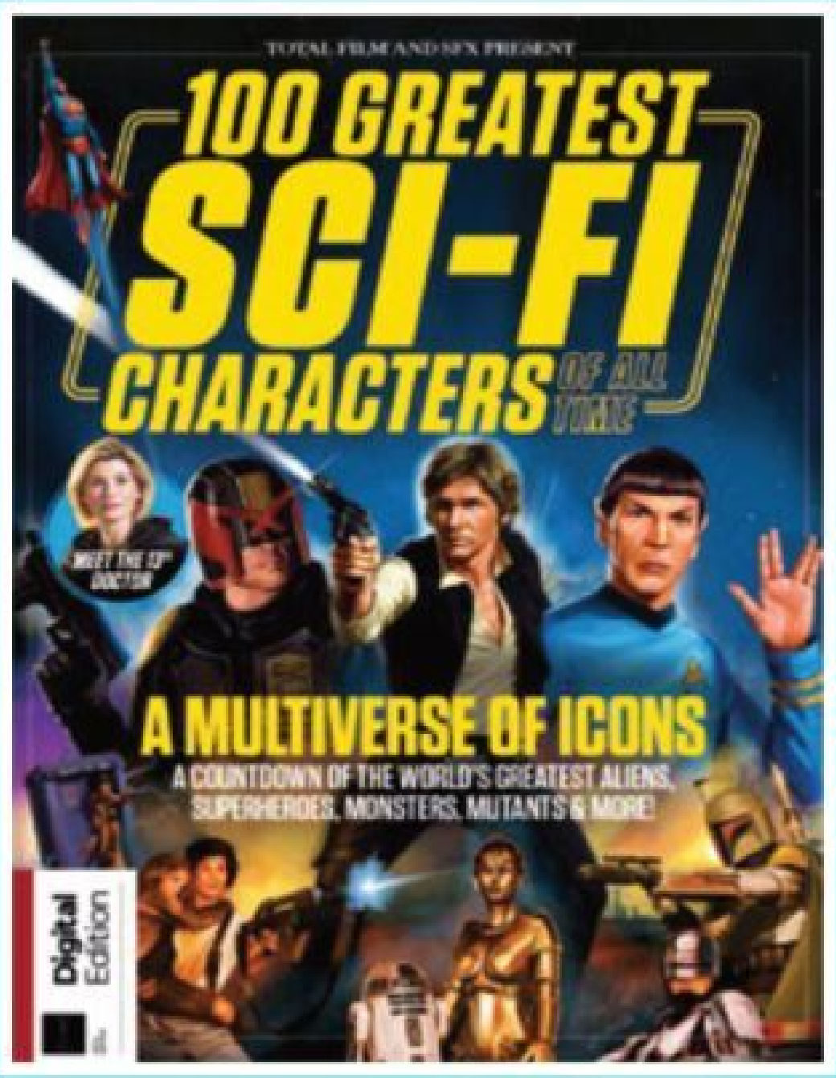
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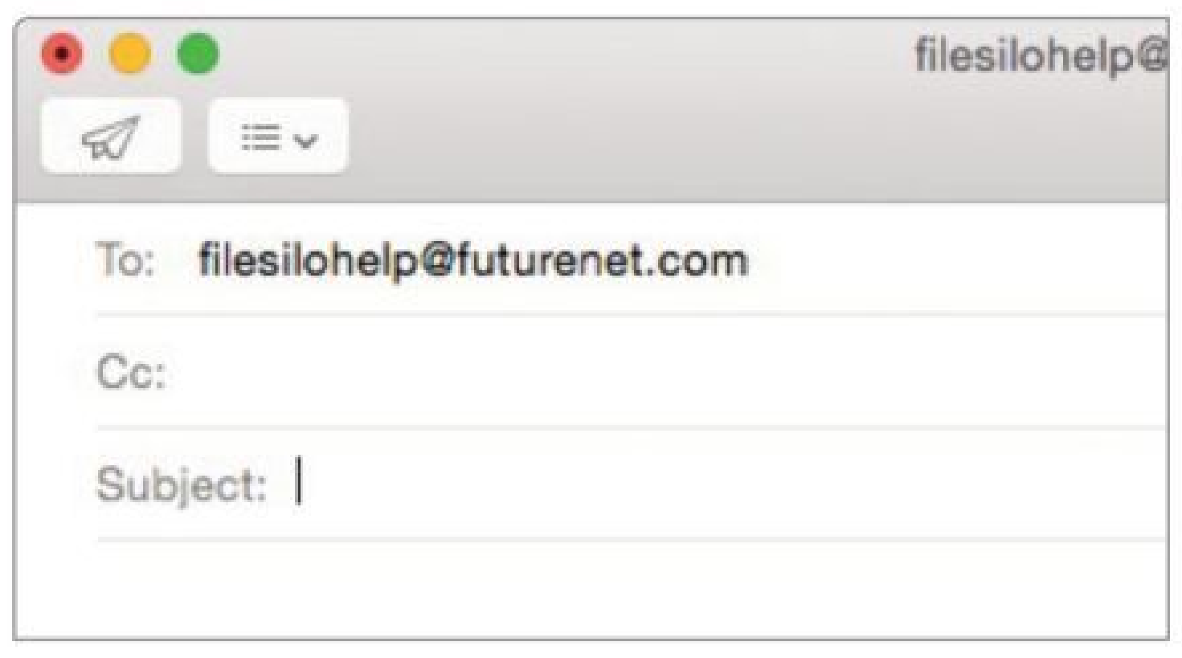
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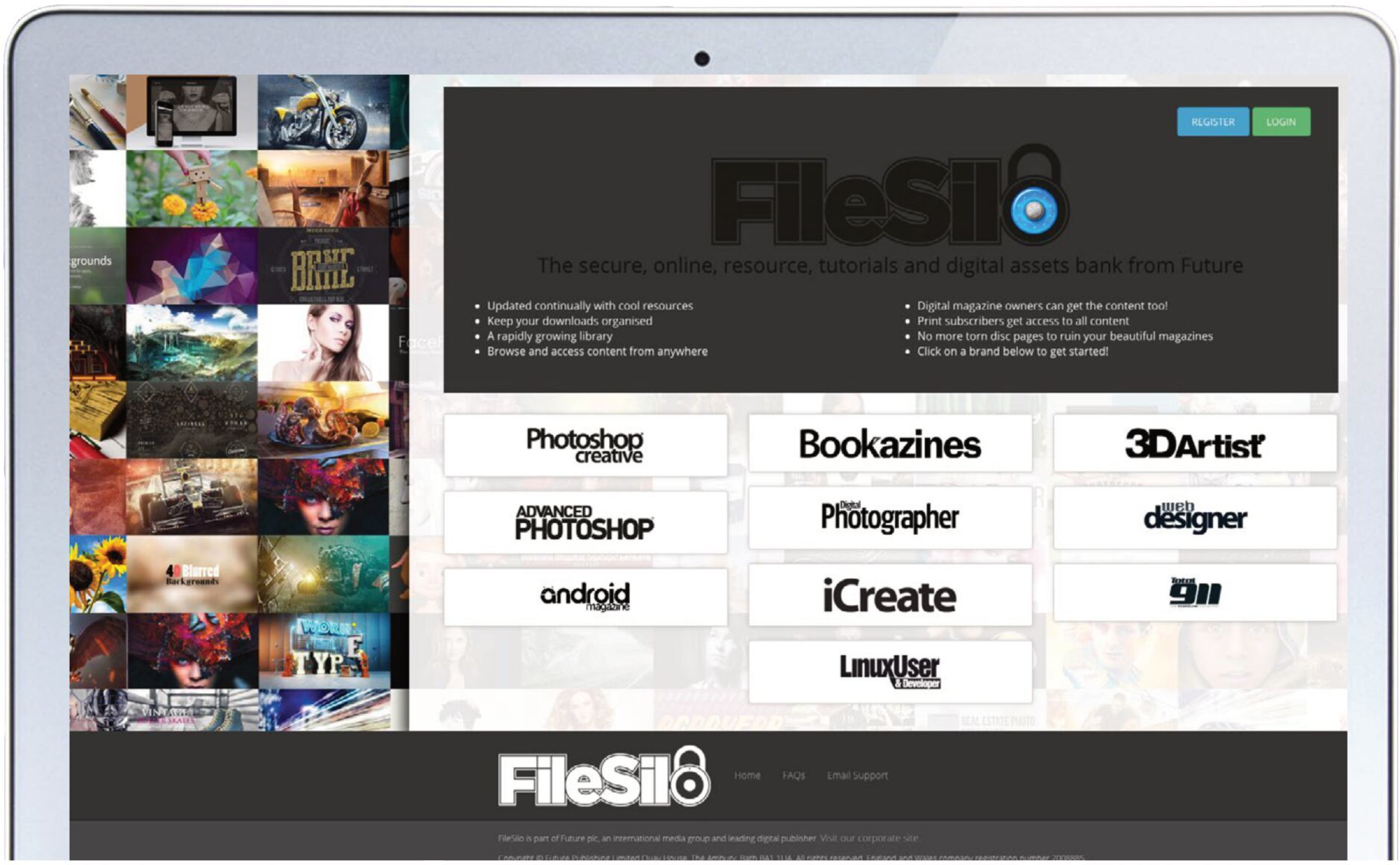
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